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AND

AMERICAN RAILWAY JOURNAL.

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INDUSTRIAL NOTES..... 100

A New York and New Jersey bridge bill has been filed with the House Committee on Commerce at Washington. This bill leaves the location of the bridge to the Secretary of War; provided, that it is not placed below 60th St. or above 71st St., New York city. All railways so desiring may connect with the bridge tracks and use these tracks on equal terms; the location of approaches on the New York side must be approved by the Commissioners of the Sinking Fund; the bridge is to be constructed at such elevation as the Secretary of War shall require, with the provision that the minimum clear headway above high water shall be not less than 150 ft.; all plans, specifications and drawings must be submitted to the Secretary of War for his approval before construction begins; the President is to appoint a board of five competent, practical, disinterested, expert bridge engineers, of whom the Chief of Engineers of the United States Army shall be one, to decide what length of span, not less than 2,000 ft., is safe and practicable for this bridge. The rate of toll is to be determined by the laws of New York and New Jersey, and the U. S. mail and U. S. troops have free passage. If this plan is accepted the company promises to expend in construction not less than $250,000 for the first year and not less than $1,000,000 annually thereafter until completed within ten years.

The Boston Subway Commission has decided to apply to the legislature for authority to extend the subway from the 3,700 ft. or thereabouts as originally proposed, to some 10,000 ft., extending it clear across the city from the Boston & Maine to the Providence stations, and increasing the total authorized cost from $2,000,000 to $5,000,000, about one-third of which sum is for land purchases, which are not properly chargeable to the subway, but to street improvements. The present idea is to prosecute the work night and day, disturbing only half the width of each street at once, and completing the entire work in two years, which last should be easily practicable.

The Nicaragua Canal bill, introduced in the Senate by Senator Morgan, provides for $100,000,000 capital stock, in $100 shares; the calling in and cancelling of all bonds hitherto issued and the satisfaction of all obligations. The company is authorized to issue $70,000,000 of 60-year bonds at 3%, the bonds to be issued from the U. S. Treasury and the payment of principal and interest to be guaranteed by the United States. Of the capital stock, $70,000,000 is to be issued to the United States in consideration of its guarantee of the bonds, $6,000,000 is to be issued to Nicaragua, and $1,500,000 to Costa Rica. The remaining $22,500,000 may be disposed of by the company, including $6,500,000 to be issued in payment of expenditures already made upon the canal. The company is prohibited from selling any of this stock at less than par and for cash, and must use the proceeds exclusively for work upon the canal. The issue of bonds to July, 1897, must not exceed $30,000,000, and the President of the United States may stop the issue prior to that time; and if default is made in the payment of interest by the company the President of the United States can foreclose.

The sterilization of water used in bathing has been reported upon by Messrs. Foster and Nijland, chemists, of Hamburg. Their purpose was to destroy the cholera microbes still possibly remaining in the water of the Elbe used for this purpose. They find that a 2.4% solution of ordinary toilet soap will kill the bacilli of cholera in from 10 to 15 minutes, or the ordinary duration of a bath. Salicylic and phenylic soaps are no more efficient, for to 150 liters of water they require 360 grammes of soap, which is practically too large a dose. On the contrary, a soap with 1% of corrosive sublimate will kill the bacilli in one minute, with a dose of 0.12 grammes of this soap to the liter of water. To sterilize the water in 10 minutes, 0.06, or even 0.03 grammes of soap per liter of water will suffice. The sublimate alone acts still better, and a solution of 1 kilo. of sublimate to 30,000,000 liters of water is sufficient to kill the cholera bacilli in 5 minutes. For an ordinary bath 5 milligrammes of the sublimate will afford every security, according to the chemists quoted.

The most serious railway accident of the week was a rear collision between an accommodation train and a freight train at Henderson, N. C., on the Seaboard Air Line, Jan. 26. The accommodation train was very much behind time, but when it stopped at the water tank the flagman did not go back far enough, and a through freight train ran into the passenger car at the rear of the accommodation, killing two persons and injuring a third.

A locomotive boiler explosion occurred at Poplar Bluff, Mo., on the St. Louis, Iron Mountain & Southern Ry., Jan. 27. The engine was a heavy freight engine about four years old, and was standing in the yard ready to go out on its regular trip. One man was injured.——The boiler of a mine locomotive in the Cranberry colliery, at Hazleton, Pa., exploded Jan. 29, seriously injuring two men.

A stationary boiler in the rolling mill of the Duncannon Iron Co., at Duncannon, Pa., exploded Jan. 29, and three men were seriously injured.——A mill boiler near Owensboro, Ky., exploded Jan. 30, killing five persons.

The new Washington bridge being built over the Housatonic River at Milford, Conn., gave way Jan. 25, owing, it is reported, to the heavy weight of snow, the structure not being completed.——A highway bridge over the river near Oakland, Wash., has been washed out by the floods.——An iron bridge under construction at Tallulah Falls, Ga., gave way last week.——A wooden bridge over the Pilatlacaba Creek near Clermont, Fla., was burned Jan. 21.

About 900 ft. of 24-in. and a mile of 10-in. Chenoweth jointless sewer pipe was recently laid at Scarborough-on-Hudson for the Elliot F. Shepard Estate. The concrete was composed of 5 parts broken stone, 2 parts concrete and 1 part Portland cement. The work was done by the Monolithic Drain & Conduit Co., whose temporary offices are at 5 Beekman St., New York, with Mr. E. C. Stout, Assoc. M. Am. Soc. C. E., as engineer in charge. The reported cost of the 2-ft. sewer was 95 cts. per lin. ft., and of the 10-in., 30 cts. per lin. ft., for conduit alone. This method of sewer construction was invented by Mr. Alex. C. Chenoweth, of New York, and was described in our issue of Oct. 17, 1891. In brief, a collapsible wooden form is used, upon which a 6-in. black malleable iron ribbon, 26-in. gage, is wound. Some concrete is put in place for the bottom, the form adjusted and the concrete tamped about it. As soon as some 2 ft. of backfilling can be done the wooden form is collapsed and removed for use in another section. The iron ribbon is left in place until the concrete has sufficiently hardened, it being joined at the end of each section by set screws. After from 24 to 48 hours the ribbon may be removed, the spiral form of the original winding enabling it to be pulled out readily.

The electrolysis of iron and lead water pipes, by the escaping current from the trolley lines, is now seriously troubling the authorities of Omaha. The lead pipe is honeycombed only in spots; but the iron pipe is completely disintegrated in places, and can be "as easily whittled with a knife as roofing slate," says the Omaha "Bee." The damage is particularly marked in the immediate vicinity of the power house. City Electrician Cowgill says that the current escapes from the tracks and takes to the pipes, imbedded in moist earth, as an easier path back to the power house; and the concentration of current near that point causes the greater damage referred to. He also notes that the iron trolley poles are rusting at the ground faster than hydrants, etc., in the same soil and neighborhood, and believes that this is caused by imperfect insulation and a consequent leakage of current. The only way to stop these various troubles is, of course, to provide ample metallic conductors for carrying the return current back to the dynamos.

The province of Bengal, India, has four main canal systems, three of which are mainly for irrigation, while the fourth, the Hijili tidal canal, is a purely navigation canal. The Sone and Midnapur canals are practically complete. The Hijili canal is also finished, except for remodelling the Kalinagar lock and laying the pipe across the Russulpur River, which are still under consideration. The extension of the distributory system and the completion of the drainage and protective works in connection with the Orissa canals, are still in progress. The total length of canals in Bengal is 916 miles, of which 495½ miles are for irrigation and navigation, 242¾ miles are for irrigation only and 178 miles are navigation channels from which there is no irrigation. There are, in addition, 2,431¼ miles of irrigating distributary channels. The area at present irrigable is 1,492,484 acres, of which 666,490 acres were irrigated during 1893. The canals were used by 219,946 boats in 1893.

A report on the proposed new water suppy for Albany, N. Y., has been made by Mr. F. P. Stearns, M. Am. Soc. C. E., of Boston. Mr Stearns favors Kinderhook Creek as a source, thinking that it would give a better water than could be secured by filtering the Hudson River water and at an annual cost about $70,000 less. The estimated cost of the work as now proposed, with a conduit five miles shorter than as originally designed, is given by Mr. Geo. Yost, an engineer employed by the water board, as $1,372,000. This includes an intake reservoir, 47,700 ft. of 54-in. steel pipe, 43,600 ft. of 39-in. steel pipe and 43,000 ft. of 36-in. cast iron pipe, all in place. The weight of the steel pipe is given as 7,598,694 lbs. for the 54-in. and 5,079,000 lbs. for the 39-in., and its cost as 3½ cts. per lb. Mr. Elnathan Sweet, M. Am. Soc. C. E., is chairman of the water board.

Investigations to determine the normal amount of chlorine in the uncontaminated natural waters of Michigan are now being made by Prof. Delos Fall, of Albion, Committee on Water Supply and Purification of Sewage-Contaminated Water of the State Board of Health. A normal chlorine map of Massachusetts, based on extended analyses, was published in the report of the Massachusetts State Board of Health for 1890.

A 72-in. submerged redwood pipe was recently completed for the Kern County Land Co. It is in the line of the Lerdo irrigation canal, carrying the canal water under Poso Creek, near Poso, Cal. It tapers at the ends to facilitate the ingress and egress of the water and thus to increase its capacity, which, with the available fall, is estimated at 170 cu. ft. per sec., or about 100,000,000 gallons per day. The staves are milled from clear redwood and measure 7⅝ ins. in width and 2⅝ ins. in thickness. The steel bands are ⅝ in. in diameter, upset in the threads to ¾ in., and are spaced 12 ins. apart. The pipe is anchored to a grillage of sills and longitudinal planking and the sand around it is protected from scouring by wooden floors, 10 ft. wide, placed at the elevation of the center of the pipe for its full length. Along the outer edges of these floors 4-in. tongued and grooved sheet piling was driven, all of which precautions are made necessary by the torrential character of Poso Creek. Mr. Walter James is Chief Engineer of the Kern County Land Co. The work was done by the Excelsior Wooden Pipe Co., of San Francisco, of which Mr. D. C. Henny is manager. We are indebted to Mr. Henny for the above information.

Municipal subways for electric wires are advocated for the streets of St. Louis, Mo., by Mr. George Barnet, president of the Board of Public Improvement, in his annual report for 1893. He believes that the importance of placing telephone, telegraph and all electric wires underground is growing more apparent every day. He estimates that a subway 4 ft. wide inside and 5 ft. high in the vertical walls, with an arch 2 ft. high from the springing line, would be amply sufficient for the wires of all kinds. He would make the walls 13 ins. thick and concrete the floor, with a drainage canal in the middle; airtight manholes and resistance coils, he believes, would provide against trouble from moisture. He estimates the total cost of such a subway at $50,000 per mile. Connections with this subway are not figured in the cost, as these, he says, should be made by the companies, and can be easily made in the sandy subsoil of St. Louis. The taxpayers of St. Louis have lately built the Mill Creek sewer at a cost of $80 per lineal foot, while this proposed subway would cost less than $10 per foot.

ENGINEERS AS COMMISSIONERS OF PUBLIC WORKS.

Within the past five or ten years American reformers have been giving much more attention than formerly to municipal institutions. Last week a national conference to consider municipal government was held at Philadelphia and one of the speakers, Mr. Carl Schurz, devoted a large part of his address to the selection of commissioners of public works, holding that they should be competent and reputable engineers. After urging that city officials of lower rank should be selected by the merit system, he takes up the higher positions and then proceeds to discuss first of all, the commissioner of public works, as follows:

It is important that the system which restricts the selection for public employment to persons of ascertained fitness should be made to cover as many places as possible. This applies not only to the lower, but also to the higher grades. To this end it seems that when municipal offices are to be filled the discharge of the duties of which requires professional knowledge, skill and experience, the selection should be confined to professional men of good standing. Let us take for an example a department about which there may be some doubt in this respect, the department of public works, meaning the department which has in its charge the matter of drainage, of water supply, of street paving, and similar things. It is certainly one of the most important branches of municipal government. There is no doubt that the administration of that department will serve the community best when not only all the laborers employed are able-bodied, steady, moral, hard-working men, each skilled according to the work he has to do, but when the men charged with the planning and the direction of the work are able, trained and experienced civil engineers. That there should be a staff of engineers answering this description nobody will dispute. The question is whether it would not be wise to make it an invariable rule that the responsible head of the department, the commissioner, or by whatever name he may go, should also be an engineer of good standing in the profession.

I know it is said that the head of such a department should possess certain qualifications other than mere professional skill; that he should have business experience and a high degree of what is commonly called executive ability. This is true. But among civil engineers executive ability is probably as abundantly found as among any other class of persons; and it will not be denied that the required executive ability combined with engineering skill and experience, will in that office be especially valuable. There is, however, another point of importance to be considered. A commissioner of public works who is not an engineer, but only an able politician, or, let us assume, for argument's sake, an able business man in the general sense, will be much more exposed to political temptation than an engineer of good standing would be. The engineer would have a professional reputation to take care of and it would be, aside from his duty to the public, his natural ambition to use the opportunities of his office for making a great name for himself in his profession. He will, therefore, be likely to make every possible effort to get rid of the intrusion of political influence, which he will soon recognize as a great danger in his path, and to make his department in the best sense a business department.

I may be reminded of the fact that in the freest countries in the world, the United States and England, it has been found wise to confine the government departments of war and of the navy to non-professional men, to civilians. But the offices of the Secretary of War and the Secretary of the Navy are political offices. (Of course political is used in its broadest sense.—Ed.) There are political duties connected with them. It is, therefore, proper that they should be given to politicians. It may be remarked, however, that almost every other government of note, the constitutional as well as the absolute, prefer for the war department a general, and for the navy department an admiral. But the office of the commissioner of public works is in no sense a political office. On the contrary, politics should be kept away from it as far as possible. And I doubt whether anything else would be more calculated to keep politics permanently away from it than, in conjunction with the extension of the civil service rules over all the inferior places, the establishment of a rule making only engineers of good standing eligible to the office of commissioner.

It may also be objected that a thoroughly upright and very able business man, not a professional engineer, may sometimes be found to fill quite successfully the office of commissioner of public works. Mr. Alfred T. White, who has recently been appointed to that place by the reform mayor of Brooklyn, Mr. Schieren, may be pointed out as an instance. Mr. White happens to have been educated as a civil engineer. But as he has for many years past followed mercantile pursuits, we may accept him as a merchant, and as such the model of a public-spirited business man in office. I am far from denying that his appointment was the ideal one under the circumstances. I am far from asserting that Mayor Schieren could have done better. I am far from fearing that Mr. White will be accessible to political influence. But I do say that the appointment of Mr. White has attracted so much attention because it is so far above the ordinary level. And I venture to say, further, that, taking a period of 25 years, a majority, if not a very large majority, of non-professional men put into that office on the ground of general business abili y would either be politicians at the start, or soon become subjected to political influence to the detriment of the public interest. On the other hand, I am far from pretending that every civil engineer put into that place would be absolutely proof against political influence. But I think I risk nothing in saying that, taking a period of 25 years, a large majority of professional engineers in that position would not become subjected to political influence, but fight it off, greatly to the benefit of the public interest. And it is such averages that we have to look to in considering the wisdom of a general rule.

The same reasoning applies to the sanitary department, which certainly should be under the exclusive control of men versed in sanitary science, who have a professional conscience to guide them, a professional reputation to take care of, and a professional ambition to spur them on.

That there is much good sense in the above most engineers will agree. Brief comment upon the subject is given in the editorial columns of this issue.

TEST OF A BELPAIRE BOILER FOR THE NEW BEDFORD WATER-WORKS.

The following information regarding recent tests of a large stationary boiler of the Belpaire type was furnished to us by its designer, Mr. F. W. Dean, M. Am. Soc. M. E., of Boston:

The boiler was built to satisfy both the future and present needs of the pumping plant of the water-works of New Bedford, Mass., and drives either a high-duty Worthington engine, a low-duty Worthington, or a simple condensing McAlpine engine, or any two of them combined. It was built with a grate surface of 45 sq. ft., which to suit present needs was reduced to 30½ sq. ft. by means of firebrick. This was decided upon as being well adapted to furnish steam for one or two engines. It is also designed to carry 160 lbs. of steam eventually, but at present carries only 115 lbs.

The boiler has diameter inside barrel of 82 ins., is 31 ft. long over all and has 160 3-in. tubes 12½ ft. long. As built the total heating surface is 1,998 sq. ft. and the total grate surface 45 sq. ft., giving a ratio between the two of 44.4 to 1, which has been increased to 65.5 to 1 by the reduction of the grate surface, as noted above.

Two tests were made by Mr. Dean, one on May 18 and the other on May 19, using George's Creek Cumberland Coal, the principal results being as follows:

Date of trial, May		18	19
Duration of trial, hours		12.3	12.26
Steam pressure in boiler, by gage, lbs		114.05	113.35
Temp. of escaping gases, after leaving feed-water heater, F.°		390.3	468.8
Temp. of feed-water, before entering boiler, F.°		158.7	154.0
Total coal consumed, lbs		3,501	6,334
Total combustible, lbs., deducting moisture and refuse		3,115	5,699
Percentage of moisture in steam		0.39	0.38
Water actually evaporated per lb. of dry coal, from average pressure and temperature, lbs		11.01	11.09
Equivalent water evaporated per lb. of dry coal from and at 122° F.	excluding feed-water heater, lbs	12.08	12 24
	including feed-water heater, lbs.	12 35	12.55
Equivalent total heat derived from a pound of dry coal	excluding heater.	11,667	11,812
	including B. T. U.	11,927	12,121
Equivalent water evaporated per lb. of combustible from and at 212° F.	excluding feed-water heater, lbs.	12.88	12.90
	including feed-water heater, lbs.	13.17	13.23
Efficiency of boilers.	excluding feed-water heater, %	77 23	78.87
	including feed-water heater, %	79.70	80.93
Dry coal actually burned per square foot of grate surface per hour, lbs.		8.85	16.06
Water evaporated from and at 212° F. per sq. ft. of heating surface per hour, lbs.		1.63	3.00

During the first test the Worthington high-duty engine was used and, as stated above, 8.85 lbs. of dry coal were burned per sq. ft. of grate per hour, and 1.63 lbs. of water were evaporated from and at 212° by each square foot of heating surface. During the second test, however, both Worthington engines were used and the above quantities were respectively 16.06 lbs. and 3.00 lbs., which are rapid rates. Notwithstanding this, the evaporation was higher on the second than on the first test, and also notwithstanding the fact that the boiler was cleaner on the first than on the second test. Mr. Dean states that the evaporative results are among the very highest on record and have seldom been equaled.

The firing was done by three men in their regular shifts, so that no unusual precautions were taken to obtain good results, except that the boiler was thoroughly cleaned before the first test. Before the second test, however, the boiler tubes were merely blown out by steam in the usual manner.

The trials were each made by getting up steam and then drawing the fires. New fires were immediately started, and great pains were taken to secure accuracy in water levels and steam pressures at the beginnings and endings of the trials.

The grates are of Cone's patent shaking type made by the I. P. Morris Co., of Philadelphia. They are coarse and well adapted for rapid combustion. The boiler has a double furnace with firebrick arches and a long combustion chamber. There is a specially designed feedwater heater in the smokebox having as much feed pipe as the space permits. The boiler was built by Edward Kendall & Sons, of Cambridgeport, Mass.

THE THIRD AVENUE CABLE RAILWAY, NEW YORK CITY.*

I.

(With inset.)

The Third Ave. Cable Ry. in New York city, which has been under construction since the spring of 1891, is now practically completed and will soon be opened for traffic by cable propulsion, its entire length. In our issues of Dec. 13 and 20, 1890, we described and illustrated in some detail the principal features of the track construction and of the cable pulleys and lifts, and in various subsequent issues have noted the progress made in the work of construction. Now that the work is completed, however, it seems of interest to review it in some detail and to illustrate and describe the features of chief interest in the construction and operation of the line. Through the courtesy of Mr. A. H. Lighthall, who was the chief engineer of the road until his resignation early in the fall of 1893, and under whose direction the design and construction of the work was carried out, we are enabled to do this very completely.

On July 3, 1853, cars were first started from 23 Chatham Square opposite Tryon Row, north as far as Sixty-first St. Shortly after this date the road was extended to Sixty-fifth St., and on July 4, 1859, it was extended as a double track to Sixty-ninth St., and a single track line opened in Harlem. A second track was, however, soon after laid on the Harlem section. At the time of the extension of the line there were very few buildings above Sixty-first St. The line now runs from Ann St., near the Postoffice, along Park Row, the Bowery and Third Ave. to 130th St., near the Harlem River, 8¼ miles, with two branches 2.5 miles and 3¼ miles long, respectively, on 125th St. and along Tenth Ave. The Tenth Ave. branch was constructed on the cable system in 1885, and about 18 months later the 125th St. branch was changed from horse to cable power. The main line, however, continued to use horse power.

In the fall of 1887 it was decided to reconstruct the main line for cable power and steps were at once taken to secure the consent of property-owners. This was easily obtained and an application was at once made to the New York State Railroad Commission and the New York city Street Commissioners for permission to tear up the streets and begin construction. The consent of the Railroad Commission was soon obtained, but the Street Commissioners refused their permission. The matter was then carried to the courts and, after an adverse decision in the city courts, the Court of Appeals finally issued an order requiring the City Commissioner to grant a permit, which he did in June, 1890.

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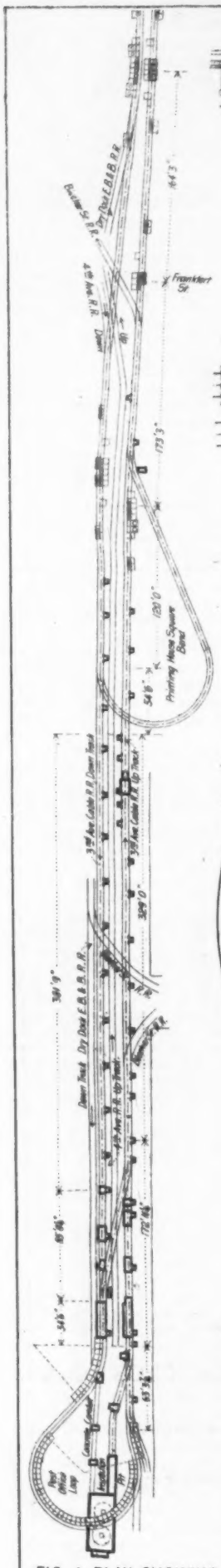


FIG. 1. PLAN SHOWING DOWNTOWN TERMINALS AND LOOPS.

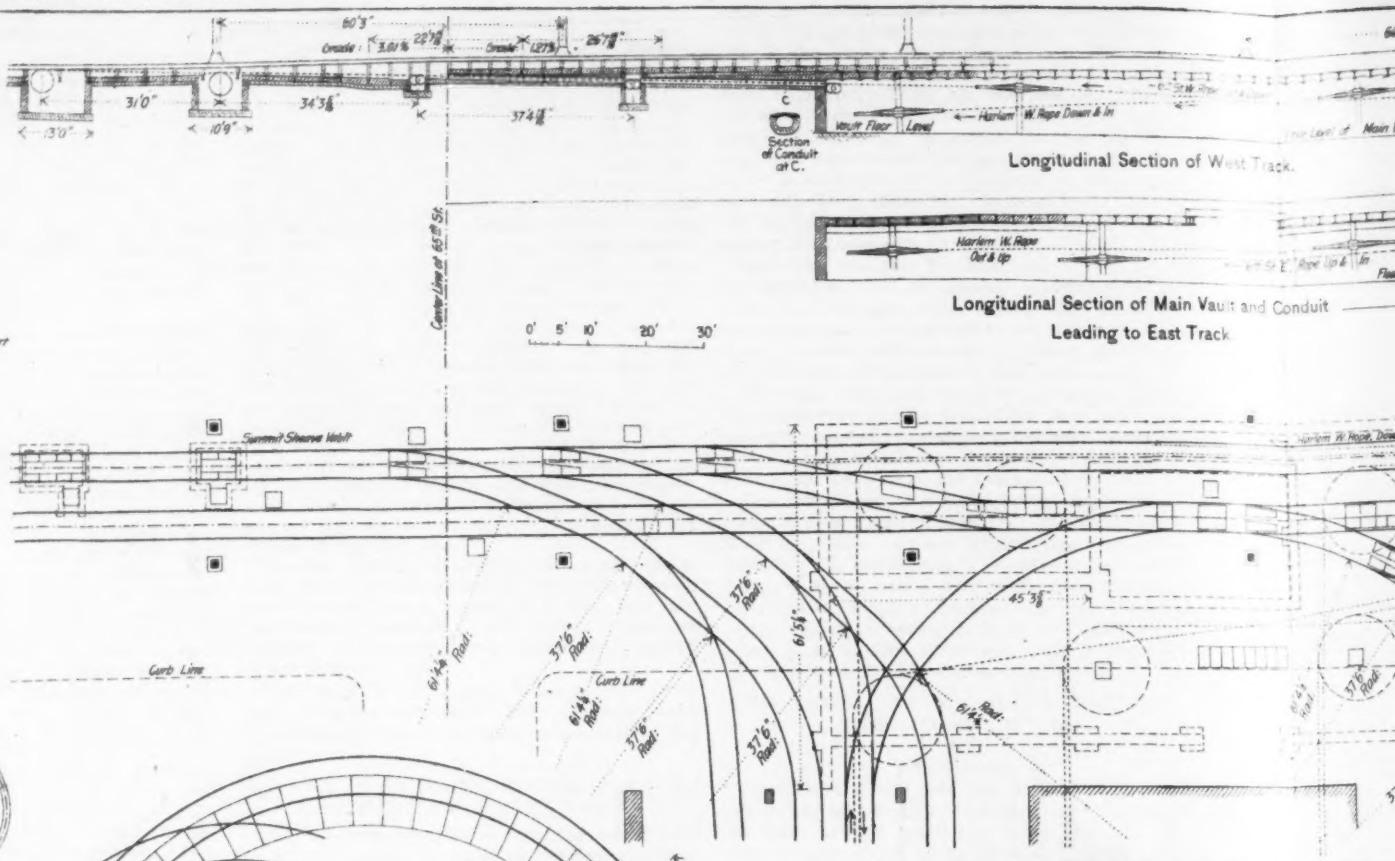

Longitudinal Section of West Track.
Longitudinal Section of Main Vault and Conduit Leading to East Track
Section of Conduit at C.
Vault Floor Level
Harlem W. Rope Down & In
Harlem W. Rope Out & Up
Center Line of 65th St.
Summit Sheave Vault
Curb Line
37'6" Rad.
61'4" Rad.
45'3⅞"
0' 5' 10' 20' 30'

FIG. 8. PLAN AND SECTIONS OF WHEEL VAULTS AND R

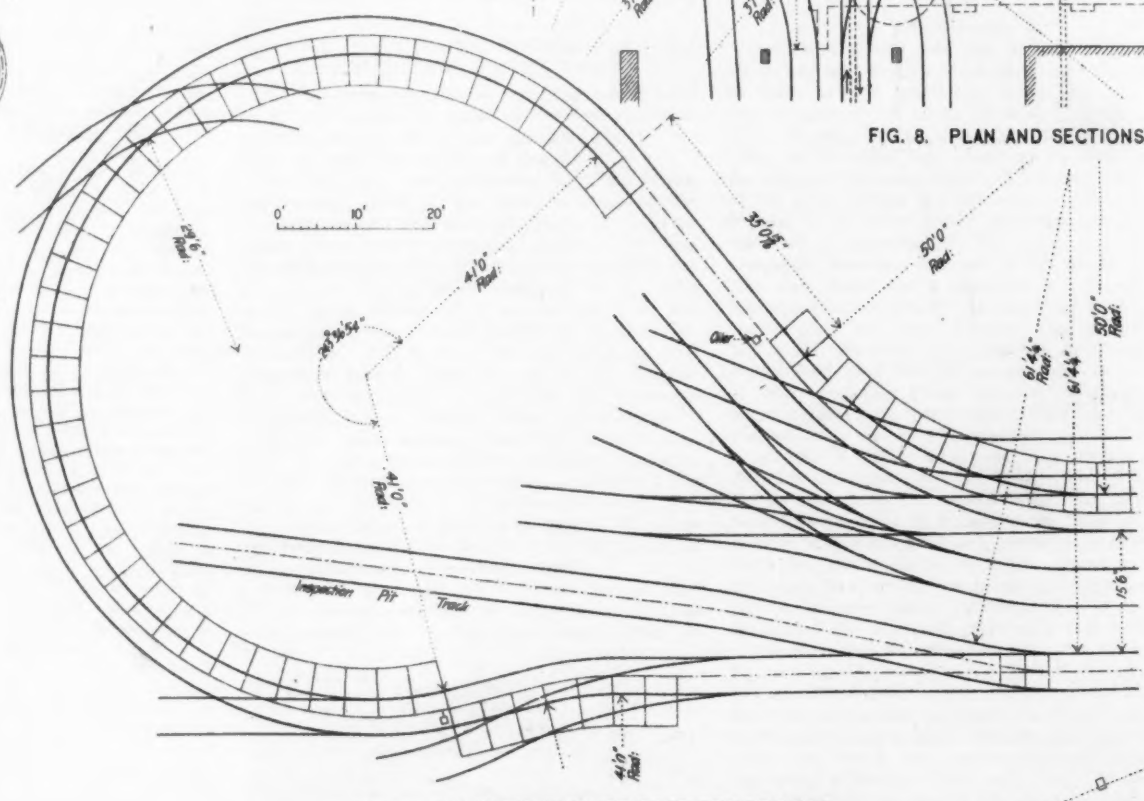


FIG. 2. ENLARGED PLAN OF POST OFFICE LOOP.

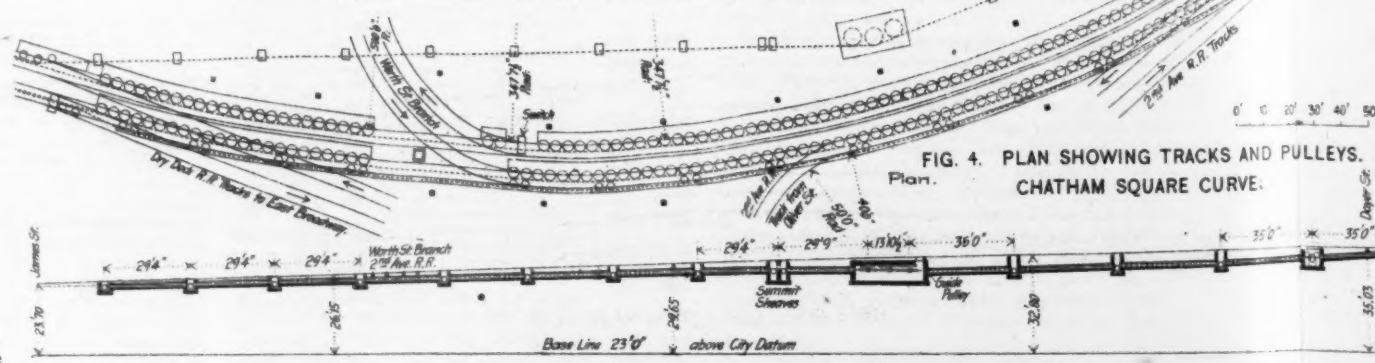
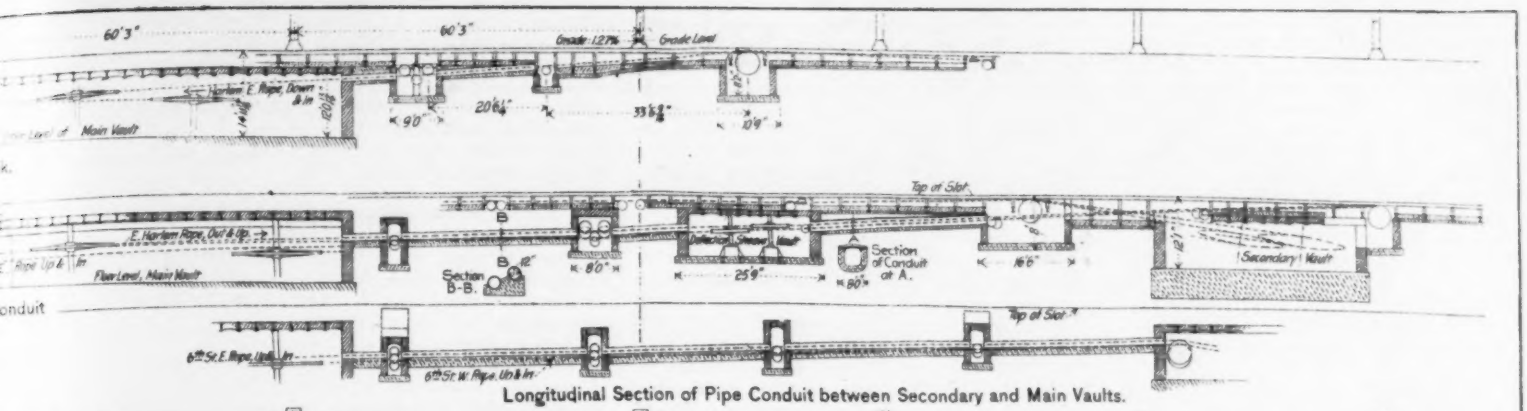
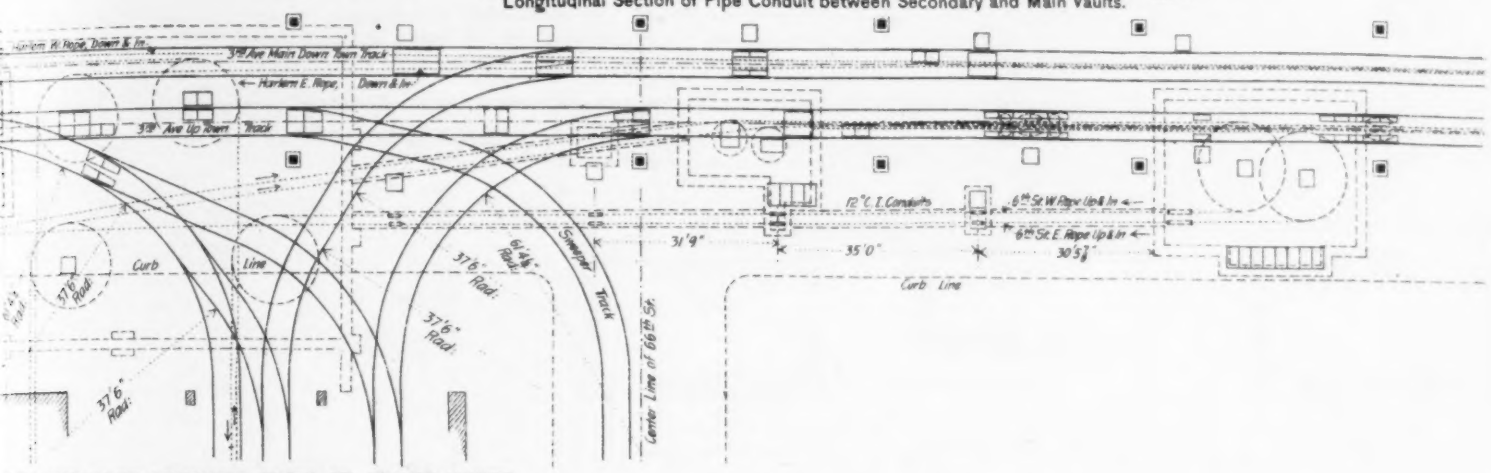

Dry Dock R.R. Tracks to East Broadway
Worth St. Branch 2nd Ave. R.R.
Track Depth Under C.L.
Curbstone Line
2nd Ave. R.R. Tracks
0' 10' 20' 30' 40' 50'
James St.
Dover St.
294" 294" 294" 294" 294" 29'9" 13'10½" 36'0" 35'0" 35'0"
23'10
26'6" 29'6" 32'10" 35'03
Summit Sheaves
Cable Pulley
Base Line 23'0" above City Datum

FIG. 4. PLAN SHOWING TRACKS AND PULLEYS. CHATHAM SQUARE CURVE.

FIG. 5. SECTION OF BLIND CONDUIT, CHATHAM SQUARE CURVE.



Longitudinal Section of Pipe Conduit between Secondary and Main Vaults.



ULTS AND ROPE CONDUITS AT 65th ST. POWER HOUSE.

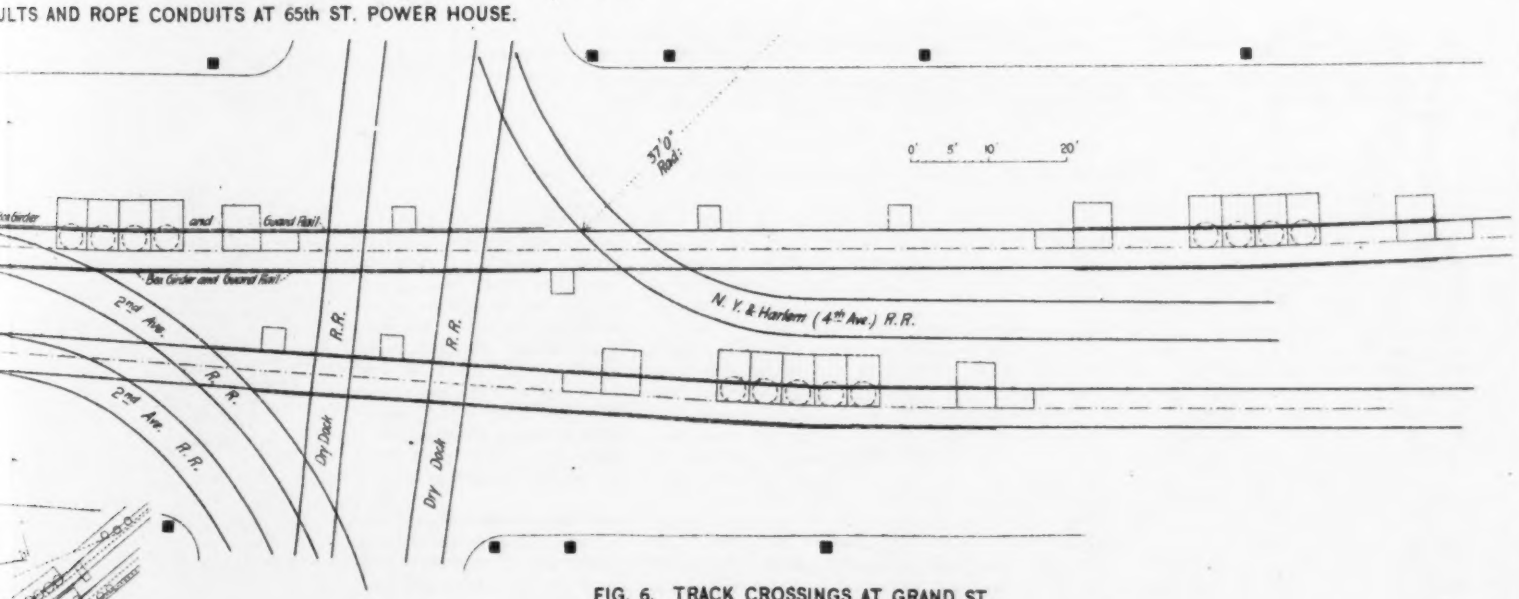
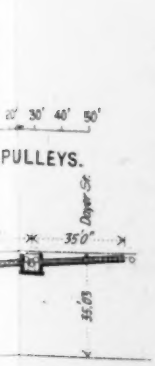


FIG. 6. TRACK CROSSINGS AT GRAND ST.



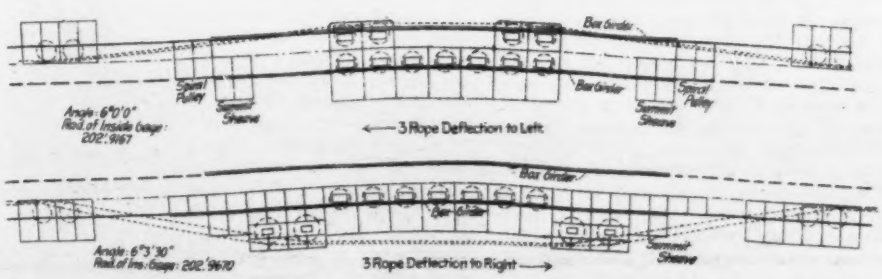


FIG. 3. THREE ROPE DEFLECTION NEAR PEARL ST.

THIRD AVE. CABLE RAILWAY;

CURVES AND TRACK CROSSINGS.

J. H. Robertson, Superintendent.

A. H. Lighthall, Chief Engineer.

CHAS. HART & SONS, LITH., 58 VESEY ST., N. Y.

The preliminary work was at once commenced. The first move made was to appoint a committee to investigate the cable railway systems in operation in many of the large cities for the purpose of selecting the best methods of construction. As a result of this investigation the duplicate system was decided upon. In October, 1890, the contract for the construction of the entire line was let to Wm. Wharton, Jr., & Co., of Philadelphia, Pa., for $1,600,000, or about $200,000 per mile of double-track. In December, 1891, however, this firm abandoned the contract, about 5½ miles of the line being then completed. A new contract was then made with Thos. E. Crimmins, who undertook the street construction for a percentage on actual expenditures. A separate contract was also made for the iron and steel. The new contractor resumed the work in February, 1892. The contract for the equipment of the power stations was let to the Pennsylvania Iron Works Co., of Philadelphia, Pa. Actual construction was begun by the original contractor for the line on March 30, 1891.

As before stated, the route of the Third Ave. Ry. extends from Ann. St., near the Postoffice, to the Harlem River, at 130th St., and the total length is 8 miles. No street corners are turned in the entire length, but there are a large number of deflections of the line, each of which, of course, requires a curve of greater or less length. In addition to these there are two loops at the lower end of the line and one at 129th St., and 35 track crossings, one of which, at 125th St., is also a cable crossing. There are eight points where other roads switch off from the Third Ave. line, and 13 crossover switches. The general plans of some of the more important of these curves and crossings are shown on our inset sheet, and will be described in detail later on.

The line is operated in three divisions, as follows: (1) The Harlem division, extending from 130th St. to the Sixty-fifth St. power station; (2) the middle division, extending from Sixty-fifth St. to Sixth St., near Cooper Union, and (3) the City Hall division, extending from Sixth St. to the southern terminus at Ann St. The cables on the two uptown divisions are operated from the main power station at Sixty-fifth St., while those of the City Hall division are operated from the Bayard St. power-house. Two cables are operated on each of the uptown divisions at a speed of nine miles per hour, and three cables, two high-speed and one low-speed, on the City Hall division. The two high-speed cables have a speed of seven miles per hour and the slow-speed cable a speed of five miles per hour. Beginning at Sixth St. the fast cable will be used to a point south of Bayard St., and then the slow cable picked up and used down through Chatham Square and Park Row and around the Postoffice loop back to the "Times" Building, where the fast cable will be again taken up for the uptown trip. By this arrangement a slow speed is obtained on the downtown section of the line where the street traffic is heavy and stops frequent. The slow speed also reduces the liability of accidents on the loop. The designing of the mechanism for bringing the fast and slow ropes into position for use and the several other features of the conduit construction necessitated by this triple cable system presented several interesting examples for solution. These will be considered in another issue and it need only be said here that one of the fast cables from Sixth St. to the terminal vault at Ann St., and the slow rope from the "Times" Building uptown to Bayard St. are carried in a blind conduit outside of the main conduit.

Loops.—Turning to the illustrations on our inset sheet, Fig. 1 is a map of a short section of the downtown end of the line, including the loops at the Postoffice and Printing-House Square, and the deflection near the junction of Center St. with Park Row. This drawing shows very clearly the general arrangement of the tracks and pulley vaults at this end of the line. An enlarged plan of the terminal or Postoffice loop is shown in Fig. 2. It is a balloon loop with a radius of 41 ft. The radii of the entrance and exit curves are 50 ft. and 41 ft., respectively. The cable is carried around this loop on 62 horizontal pulleys, each 33⅜ ins. in diameter. It will be remembered that it is the slow cable that rounds this curve. The fast cables coming downtown run in a blind conduit to the horizontal terminal sheaves, shown in plan in Fig. 1, which they round, and thence runs in the main conduit uptown.

None of the cables pass around the loop at Printing-House Square, and in fact this is to be used only in case of a blockade, when the cars will be transferred by horses. As will be seen, this loop branches off the west track, crosses the east track and curves around to the east and north to join the east or uptown track.

The Harlem terminal loop turns into 129th St., where it divides into 26 parallel tracks which lead over the pits in the car barn and emerge at 130th St., where they converge and return to Third Ave. The cables do not round the barn loops, but pass around terminal sheaves just north of 130th St., and a Connelly gas motor is employed for hauling the cars to and from the barn.

Deflections.—The deflection at the junction of Park Row and Center St. is shown in Fig. 1. There are 28 of these deflections on the line, at each of which it was necessary to employ curve pulleys. Two of the most important of these are shown in plan on the inset sheet. Fig. 3 shows the three-rope deflection on Park Row, near Pearl St., and is typical of all three-rope deflections on the line. As will be seen, the cables in use run in the main conduit, while the idle rope is carried to one side around horizontal sheaves, as shown. Details of the spiral groove pulleys used at these deflections will be shown later. The second curve noted as shown on the inset sheet, is the long compound curve at Chatham Square. This curve is 500 ft. in length with radii varying from 280 ft. to 500 ft. in length. The arrangement of the curve pulleys and vaults is clearly shown on this plan, Fig. 4. It will be seen that the third cable going downtown does not run in the main conduit, but in a separate conduit, forming a chord to the curve. This extra conduit is shown in section in Fig. 5. The third cable uptown runs in the blind conduit to the right of the main conduit, as shown on the plan, Fig. 4. By following the dotted lines, which represent the cables, this arrangement will be clearly understood. As will be seen from the plan, a subway is constructed on the inside of the curves on each track to provide a passageway for the inspection of the pulleys. This subway is constructed of brick and is 4 ft. wide and 5½ ft. high.

Track Crossings.—There are 35 track crossings on the line, one of which is a cable crossing, and eight points where other roads switch off from the Third Ave. line. The crossing at Grand St., which is one of the more complicated, is shown in Fig. 6. At this point the Third Ave. lines are crossed at nearly right angles by the crosstown lines of the Dry Dock R. R., and also by the uptown track of the New York & Harlem R. R., more familiarly known as the Fourth Ave. road. The Second Ave. R. R. switches off the Third Ave. tracks just south of Grand St., as shown. The switches are so constructed that the cable cars continue on the main track and ride over them, while the horse cars of the other line switch off as required.

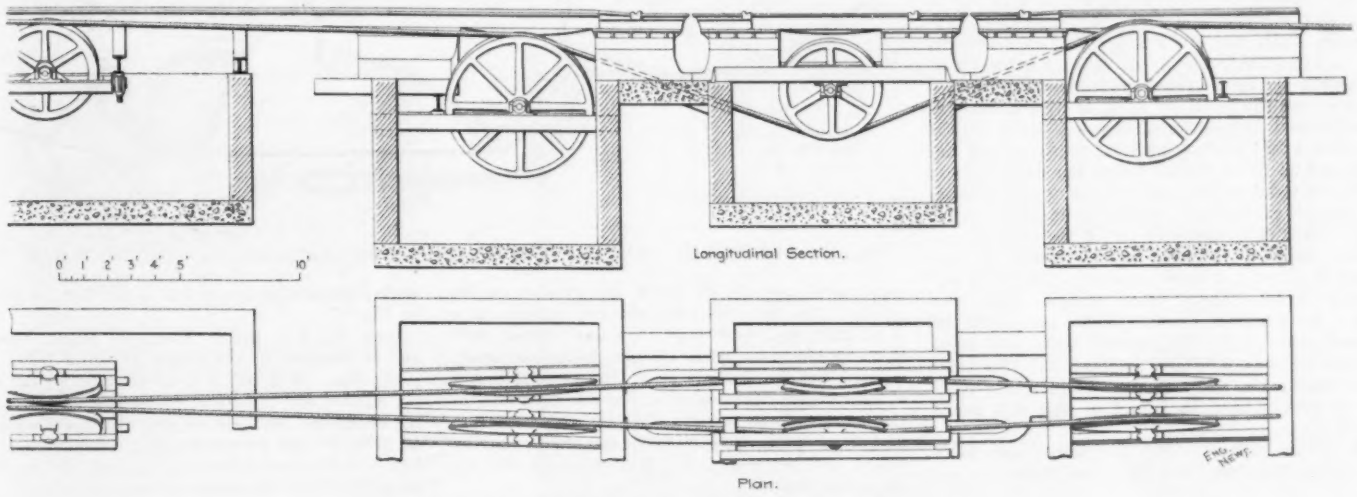


FIG. 7. CABLE CROSSING AT 125TH ST. AND THIRD AVE.

A plan and section of the crossing at 125th St. are shown in Fig. 7. This is a cable crossing, the tracks of the 125th St. branch of the Third Ave. R. R. crossing those of the main line at right angles. As will be seen the cables of the main line are depressed while those of the 125th St. branch cross above them. Automatic lifting devices bring the depressed cable into position to be taken by the grips at this point. These are supplemented by hand lifts to be used in case the automatic lifts fail to operate.

Arrangement of Tracks at Sixty-fifth St.—In Fig. 8 are shown a plan and sections of the conduits and vaults at the main power station at Sixty-fifth St. Four sets of cables are operated from this station; two for the Harlem division to 130th St. and two for the middle division to Sixth St. The arrangement of the cables and the carrying pulleys is clearly shown by the drawings.

WATER PURIFICATION IN AMERICA.

(Continued from p. 66.)

Various Systems of Filtration at Denver, Colo.

The history of water purification at Denver, Colo., covers a period of over 20 years, and involves nearly all the types of filtration which have been tried in this country. Large infiltration wells were first used, then a filter crib in a reservoir through which the water passed horizontally. This was followed by infiltration galleries and finally by gravity mechanical filters. Some of the changes were made because of contamination to the supply and others were caused by the necessity of securing additional water. The large well and the filter crib were abandoned many years ago. The infiltration galleries are still in use and the mechanical filters were put in operation less than a year ago.

Some form of water purification at Denver has

been made necessary, or desirable, by the fact that the streams in the vicinity of the city are subject to floods during periods of melting snow and heavy rains, at which time they carry a large amount of matter in suspension. Besides this, vegetable matter in these streams at times renders the water unfit for use after standing exposed to the sun. In addition the unstable character of the stream flow at points near the city rendered desirable the combination of just such underground development and water purification schemes as have been tried.

Before passing to a description of the different filtering systems it may be stated that a second water company—the Citizens'—put works in operation in 1890 and that both it and the present American Water-Works Co. now supply the city. The latter company was formerly known as the Denver City Water Co. The Citizens' Water Co. has a system of infiltration wells on the South Platte River and owns the mechanical filters described herein.

The Old Infiltration Well.—The first attempt at water purification at Denver seems to have been made in connection with the original works built by the Denver City Water Co., which were put in operation for domestic and fire purposes in November, 1871, the Holly Mfg. Co., of Lockport, N. Y., being the contractors. A large cribbed well was sunk in the saturated sand adjoining the east bank of the Platte River near or within the city. The internal dimensions of this well were 42×56 ft., with a 20×60-ft. branch extending toward the river, all 22 ft. in depth. When the well was put in it was about 100 ft. from the water in the river, the branch extending to within about 40 ft. of the river bank. The lower 10 ft. of the crib was of timber with 4 ft. of stone in the center, and the upper 12 ft. was of stone masonry. The walls extended 2 ft. above the surface and the well was roofed over with an ordinary trussed gable roof. The reported daily yield from this source was 3,000,000 gallons, but this soon grew inadequate, and a pipe was laid to the river for emergency use. In 1884 this well was abandoned.

The Filter Crib.—In 1880 new works were built farther up the river, with Mr. John Pierce as engineer, water being taken through a canal which expanded into a basin called Lake Archer. Some of the suspended matter in the water was removed by sedimentation during its passage through the canal and lake. Butterfly gates were provided near the upper end of the canal for shutting off the flow and flushing out the sand deposited in this section. Before going to the pumps the water was passed through a filter crib consisting of a central well 10 ft. wide by 100 ft. long, surrounded by two cribs 10 ft. apart filled between with ordinary river gravel screened to three or four grades, with the coarsest material on the outside. The water in the forebay was 15 ft. deep and the crib extended 1 ft. above the high water line, or to a height of 16 ft. Thus the inner sides of the crib had an available area of 3,600 sq. ft. The infiltration was horizontal and a 24-in. suction pipe extended from the inner well across the forebay to the pumps. When first constructed the filter crib would yield 5,000,000 gallons per day, but at the end of nine months it had entirely sealed up, compelling the company to take water directly from the forebay.

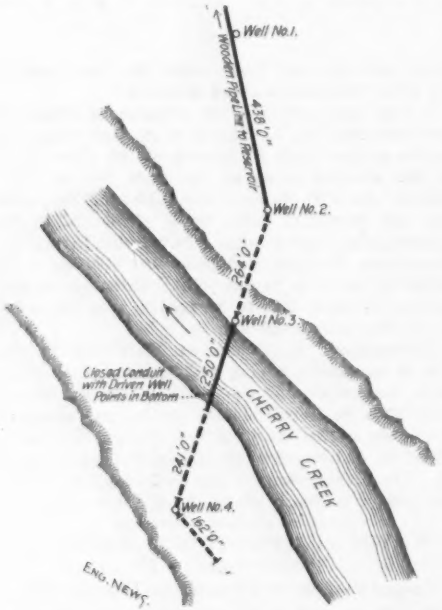


Fig. 12. Location of Cherry Creek Infiltration Wells and Galleries.

The Denver Water Co.'s Platte River Infiltration Galleries.—In the early spring of 1884 the bed, like the original well, was entirely abandoned for a supply still farther up the river from some 1,200 ft. of infiltration galleries about at right angles to the banks of the river, with their bottoms about 16 ft. below low water, 18 ft. below high water and 20 ft. below the surface of the ground. The galleries were about 4 ft. wide, 2 to 4 ft. high and were built of rough lumber with ⅜-in. spaces at the sides, the tops being completely covered and the bottoms open. The formation was of coarse gravel and most of the water entered at the bottom of the gallery. The galleries were connected by 4-ft. circular wood stave pipe having bolted to it perforated cast iron plates for the admission of water.*

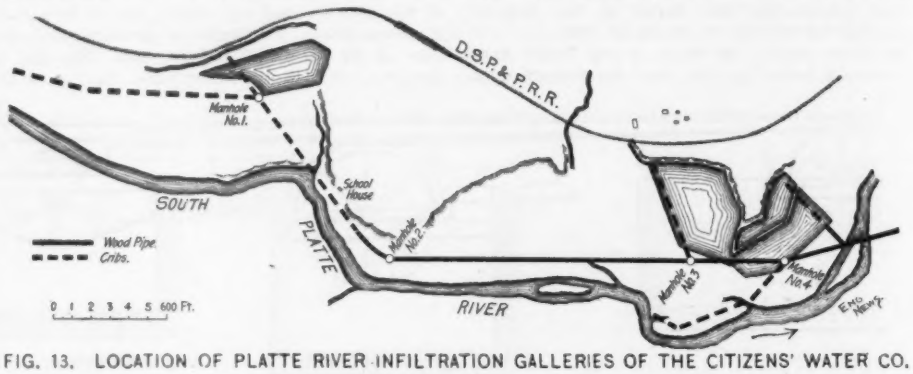


FIG. 13. LOCATION OF PLATTE RIVER INFILTRATION GALLERIES OF THE CITIZENS' WATER CO.

All the galleries put in 1883, and put in use in 1884, had flat tops. Several hundred feet of galleries 6 ft. in height have since been added, it being thought that the greater height would admit of more easy renewal of the part above water, upon rotting. It is said that this plan has not been satisfactory.

The yield of these galleries varied from 12,000,000 to 18,000,000 gallons, the latter being at river floods, and in 1888 was given as 16,000,000 gallons. A part of this yield is doubtless from the underflow, while the remainder comes directly from the river, but the relative amounts from each source cannot be given. It is said that this yield has been reduced by the wastes from a paper mill on the river above, a film of paper pulp forming on the gravel bed and banks of the stream and checking the passage of water. In 1889 these galleries were extended, with Mr. Donald W. Campbell as engineer, and in 1892 deeper cribs were dug to obviate the clogging just mentioned, which deepening necessitates the use of centrifugal pumps to lift the water thus developed to the 4-ft. wood gravity conduit leading to the 12,000,000-gallon reservoir, from which it is pumped to the city.

Mr. Chas. P. Allen, of Denver, who designed these wells, states that until 1889 the yield did not diminish, as only about 16,000,000 gallons per day were drawn from them. He believes that an overdraft on such galleries tends to close up the interstices through which water comes to them, instead of opening them wider, and thinks that experience with these wells has shown this to be true.

* The location of the old canal and filter bed, the new galleries, conduit, reservoir and pumping station, together with sections of the infiltration galleries, are shown in Engineering News of Sept. 22 and 29, 1888, from which the above and some of the information given below has been partially drawn. The source just named has been supplemented by facts from a paper on the Denver Water-Works by Mr. Jas. D. Schuyler, M. Am. Soc. C. E., read Sept. 20 before the American Society of Civil Engineers, and also by notes from Mr. W. F. Allen, son of Mr. Chas. P. Allen, Chief Engineer of the old company from 1876 to 1890.

The Denver Water Co.'s Cherry Creek Infiltration Galleries.—In the spring of 1886 it became necessary to develop more water, which was done under the direction of the engineer of the company, Mr. Chas. P. Allen, of Denver. It was decided to obtain a gravity supply from the underflow of Cherry Creek at a point some eight miles from the center of the city, the method of development to be similar to that on the Platte River, just described, supplemented by four cribbed wells near and joined to the gallery. This work was begun in 1886 and completed in 1887. The creek has a small normal flow and during dry weather carries little or no water at the surface, but though not fed by perennial snow, it has a large drainage area of prairie land and a wide, deep bed of sand beneath it and on either side. In the summer of 1886 the ground water near the creek was 8 ft. below the ground surface. The location of the wells and galleries in relation to the creek is shown by Fig. 12.

Well No. 1 is 438 ft. down the supply conduit and is designed to tap a body of water below the grade line. Well No. 2 is at the head of the supply conduit and is 14½ ft., outside diameter, while the others are but 10 ft. From well No. 2 a length of 30 ft. of pipe connects with the infiltration gallery, which extends 264 ft. to the bed of the creek, where 30 ft. of pipe connects with well No. 3. As the creek is liable to floods, which stir up its sandy bottom to a considerable depth, it was thought best to lay a closed box or pipe beneath the bed of the creek with 2-in. well points in its bottom, in place of the regular gallery, thus avoiding both roily water and the silting up of the pipe. This section is 250 ft. long and at the other side of the creek connects with 241 ft. of arched gallery, where another 30 ft. of pipe connects with well No. 4. The opposite side of the sand bed having been nearly reached the gallery extends upstream from the last well, this section being 162 ft. long and making the total length of the gallery 917 ft., if the section beneath the river with its driven well points is included.

The galleries are from 13 to 17 ft. below the surface of the ground and the wells from 20 to 25 ft., but in each large well a small one, tapering from 30 ins. at the top to 12 at the bottom, extends nearly to the bedrock, some 35 ft. below the ground surface. Both the sides and top of the galleries and the lower part of the wells were built of layers of 2-in. lumber, planed to make tight joints and prevent sand from coming in at the tops and sides, all water coming in at the bottom. All the horizontal galleries at Cherry Creek had circular tops. The galleries cost about $5 per lin. ft., including excavation. The wells were cased with oak and had the upper part of their walls of brick, domed over to form roofs. These vertical wells cost $2.10 per lin. ft., excluding excavation.

It is stated that the galleries and wells yielded 9,000,000 gallons per day at first, but after a few months began to give less and less water until they yielded only 2,000,000 gallons. The yield increases to 5,000,000 gallons per day, after a flood, or when waste water is turned down the creek from the high line ditch.

The water from the wells flows through about five miles of 37-in. wood pipe to a 7,000,000-gallon covered reservoir, which has proved very beneficial in excluding sunlight and algae and other troublesome growths.

Two or three years ago a second development

was begun on Cherry Creek, about a mile above the old galleries, regarding which no extended information is at hand. It is reported that a large sum of money was expended without adequate return, and that an excavation some 100×200 ft. × 25 ft. deep was made and the water secured was conveyed by a flume to the conduit below, but that this cut off the flow from the old galleries and developed only 2,000,000 to 3,000,000 gallons of water per day. The present supply of the American Water-Works Co., which succeeded the Denver City Water Co., is from the Cherry Creek source and the infiltration wells and galleries on the Platte River, described above.

The Citizens' Water Co.'s Platte River Infiltration Galleries.—In 1889 the Citizens' Water Co. was organized as a rival to the old company, and since that time has developed a supply from infiltration galleries near the Platte River and just below Platte Canyon, which was put in use in November, 1890, and has also put in two rapid gravity sand filtration plants for purifying water taken still farther up the Platte River, in Platte Canyon. The location of the galleries is shown by Fig. 13.

These galleries are 30 ins. wide and about 24 ins. high, inside, with sides of 2×4-in. rough lumber,

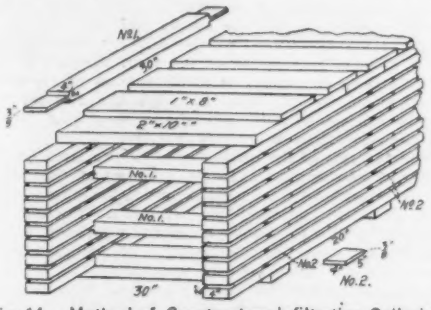


Fig. 14. Method of Constructing Infiltration Galleries of Citizens' Water Co.

laid flat with ⅜-in. interstices, and are tightly covered with plank, as shown by Fig. 14. There are 3,584 ft. of main and 328 ft. of lateral galleries, having about 15 ft. of sand above them. The principal yield is said to be from the bottom of the galleries. For the first few months after completion the yield of these galleries was but 3,260,000 gallons per day. The yield was increased to over 8,000,000 gallons by constructing ponds, shown in plan by Fig. 13, with a combined area of about 20 acres and a water depth of about 5 ft. The ponds are filled with water from the river and cover a small portion of the galleries. They were constructed about a year after the galleries were put in use, at a cost of about $2,000.

Nearly the whole of the beds of the ponds are cleaned once a year at a cost of about $1,000, water first being drawn off, then the silt scraped up and removed and the gravel loosened by plowing.

In November, 1893, the yield of these galleries per day was given as 8,200,000 gallons, which is 837 gallons per sq. ft. of bottom area, against 333 gallons before flooding, or an increase of about 150%. At the original rate of filtration the cost of the galleries, $6.89 per lin. ft., or a total of $26,950, was $8,268 per 1,000,000 gallons yield. The cost of construction per 1,000,000 gallons of present yield, according to the above figures, is $3,520. It must be remembered that the infiltration galleries are to some extent a mode of developing water, so their total cost cannot be charged to the purification account. These galleries were designed and constructed by Mr. C. P. Allen, Chief Engineer of the Citizens' Water Co., who was also the engineer of the Denver City Water Co. from 1875 to 1889.

The Mechanical Filters of the Citizens' Water Co.—As stated above the Citizens' Water Co. has recently introduced a water supply drawn from the Platte River, at a point in Platte Canyon, some 20 miles above the city, in connection with which two batteries of gravity mechanical filters are used.

One of the new filtration plants is located about 4½ miles below the head of the supply conduit and about three miles below the arched pipe bridge over the Platte River, described in Engineering News of Aug. 31, 1893. The other plant is at Marston Lake, a 5,000,000,000-gallon storage reservoir, some two miles west of the by-pass connection shown in the above-named issue. The Canyon plant was put in operation in May, 1893. The lake plant has not been in constant use as yet, owing to the fact that since its completion the lake has been but little drawn upon. Next spring the company proposes to build additional filters, making the total capacity of the new plants 25,000,000 per day. While filtration may not be necessary the year round, it appears that the water is never so good as not to be benefited by the process, which might also be said of many other water supplies.

Each plant consists of ten tanks with a daily capacity of 500,000 gallons each, arranged on both sides of a supply flume and a clear water conduit, with connections as shown in detail in Fig. 15. Each tank has a clear water chamber at the bottom above which is the filtering material in four compartments, the partitions of which extend nearly to the top of the filter and support a central water distributing tank. Flap valves, lifted by vertical rods, control the water supply to each filtering compartment.

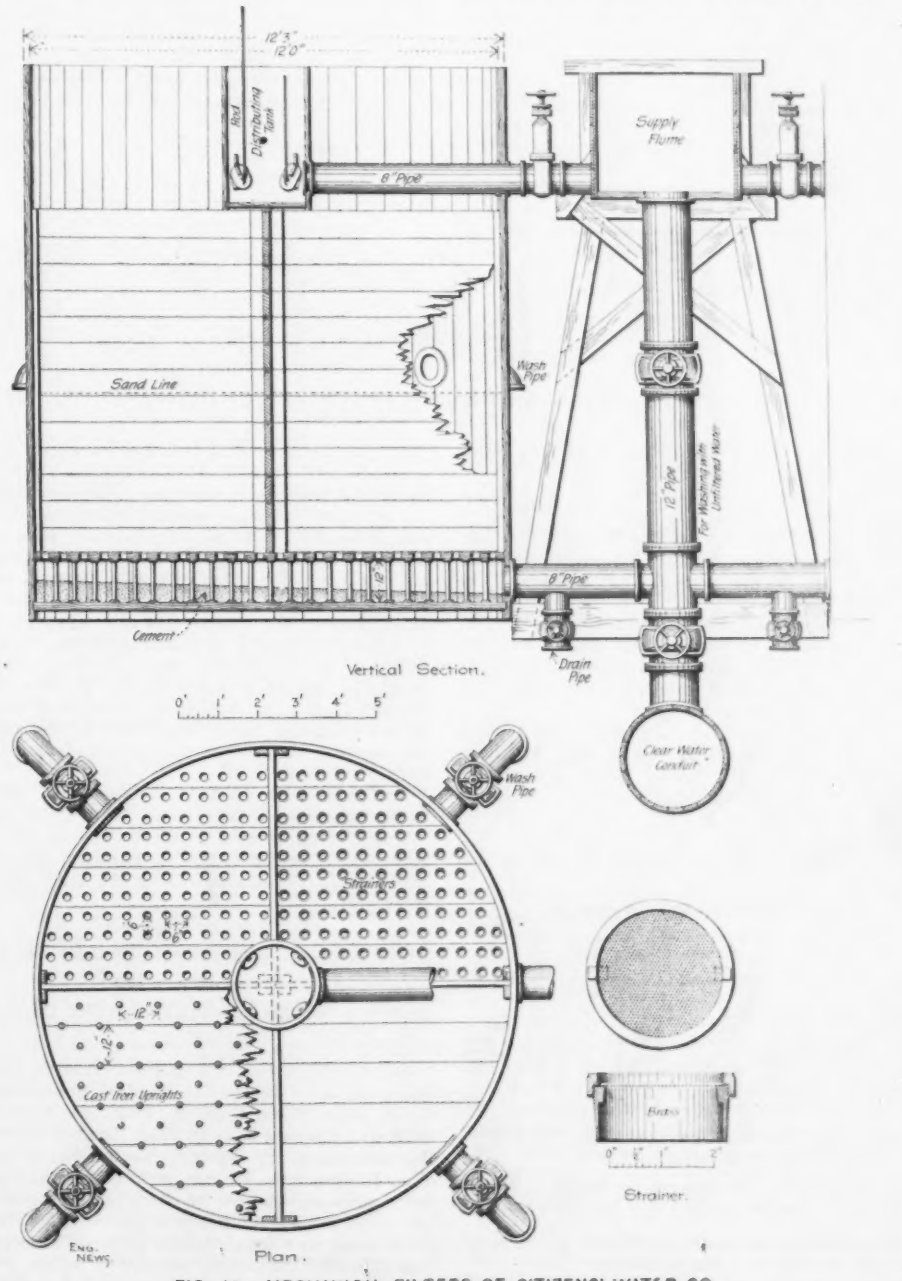


FIG. 15. MECHANICAL FILTERS OF CITIZENS' WATER CO.

The false bottoms of the tanks, their supports, and the strainers through which the filtered water pass are clearly shown by the plan and section of the tank and the details of the strainer, all given in Fig. 15. The strainers are of aluminum-bronze, and have about 150 perforations per sq. in. There are about 425 strainers to each tank, having an effective area 2.3 ins. in diameter, which gives a total strainer area of about 12 sq. ft., or over 10% of the bottom area of the tank.

To facilitate cleaning, the bottom of the clear water chamber is filled with cement, which slopes toward the clear water pipe.

The filtering material is of the same size from top to bottom, and consists of 4 ft. of coarse screened Platte River sand, a large proportion of which is white quartz. It is stated that the depth of water on the filter is between 6 and 7 ft. The area of each filter is 113 sq. ft., which with a capacity of 500,000 gallons per filter gives a rate of filtration of 4,425 gallons per sq. ft., or over 100,000,000 gallons per acre, and a vertical rate of nearly 5 ins. per minute.

The filters are designed for washing in sections by a reversed flow of either filtered or unfiltered water and for allowing the first filtered water after washing to waste until it runs clear.

To wash a section with filtered water without stopping filtration in the other sections the flap valve controlling the flow to this section is closed and the wash pipe valve opened. The valve just above the clear water conduit is then partially closed so as to cause the filtered water from the three sections in use to pass up through the other

section, washing out the impurities in the sand and finally wasting through the wash pipe. Of course the rate of filtration in the remaining three compartments, and also in the other filter of the pair, is reduced during the washing, but still filtration is everywhere in progress except in the one compartment being washed. It might prove more expeditious to turn all the filtered water from a pair of filters into the compartment being washed than to allow some of it to go to the clear water conduit. This would seem to be undoubtedly the case whenever the first filtered water after washing was discolored, which it is said to be always to a greater or less extent, as it is then desirable to waste filtered water until it runs clear, which can only be done by excluding the water of a pair of filters from the clear water conduit and wasting it through the drain pipes shown on Fig. 15.

Since the last sentence was written it has been learned that the filters are usually washed as suggested, all the filtered water being turned into one compartment, it being intended always to have a surplus capacity which will permit this.

To wash with unfiltered water filtration must be entirely stopped in one pair of filters and the water from the supply flume turned down the vertical pipe and into the clear water chamber at the bottom of the filter, connection with the clear water conduit first having been cut off. Then by opening the wash pipes successively one compartment after another may be washed, after which filtered water may also be used for completing the work and the filter drained before again put in use, or the first filtered water may be wasted.

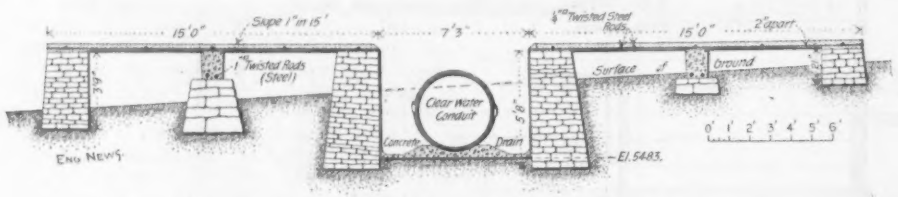


FIG. 16. CROSS SECTION THROUGH FOUNDATIONS OF FILTERS.

It is stated that under ordinary circumstances the filters should be washed once in six hours and that to wash one tank takes about 15 minutes. The amount of water required for washing has never been measured.

A single analysis of the water before and another after filtration without the use of alum has been made by Mr. Wm. C. Strong. These analyses, together with the average of three analyses of water from the infiltration galleries at Platte Canyon, after passing through a pipe system to the University Building, at University Park, are as follows:

(Parts per 100,000, except hardness.)

	Canyon filtering plant.			Infiltration galleries.
	Unfiltered.	Filtered.	P. c. decrease or increase.	Aug. 10, 11, 12.
Date	Sept. 6-7.	Sept. 6-7.	Sept. 6-7.	
Total solids	28.6	22.2	−22.4	.....
Chlorine	5.63	5.55	− 2.1	3.62
Free ammonia	0.0027	0.0030	+11.1	0.0004
Albuminoid ammonia	0.0250	0.0112	−50.5	0.0125
Total ammonia	0.0277	0.0142	−48.7	0.0129
Hardness	14.4	14.4	0.0	11.0
Clearness	Turbid	Clear	....	Clear

Mr. Strong states in his report that the following facts appear from his analyses:

(1) Substances in solution are unaffected in the filtering plant, such as common salt, lime salts and ammonia salts.

(2) A little more than half of the organic matter along with all the suspended clay is removed.

(3) The artificial and natural filtrations are nearly equal in effectiveness.

The rate of filtration at the time the samples of filter effluent were taken was about 4½ ins. per minute, or 4,050 gallons per sq. ft. per day, which is equivalent to about 75,000,000 gallons per acre and about 10% less than the rated capacity of the filters. The results from the filter tanks and galleries, without more data regarding the original source of the gallery water, can be compared only as to the quality of the water and not as to the efficiency of the two processes. It will be noticed that the chlorine is high in the above samples. Later chlorine determinations by Mr. Strong for water from the Platte River and feeders of the same about 40 miles above Denver show that the chlorine at those points is higher than at Denver and that it is low in the feeders, as compared with the river itself. In Goose Creek there were 0.36 part of chlorine per 100,000, in Trout Creek 1.00, and in the Platte River 6.50 parts. The samples from the infiltration galleries showed only 3.62 parts of chlorine. These points are all in the main range of the Rocky Mts. and are said to be free from possible contamination, so the chlorine must come from the soil at certain stretches on the streams.

The company's construction account shows the cost of the filter plants as $2,500 per 1,000,000 gallons capacity, including the foundations described below. In operation, thus far, a day and a night man is employed for a 5,000,000-gallon plant, their wages being $1.75 each per day, which is at the rate of 70 cts. per 1,000,000 gallons capacity for labor. It is thought that the same men could handle a 7,000,000-gallon plant, which would reduce the cost for labor to 50 cts. per 1,000,000 gallons.

The foundations for the floors of the two rows of filters sustain a load of 337 lbs. per sq. ft., and are shown by Fig. 16. The four main walls and the center piers are of sandstone. The piers are 2 ft. square at the top, located midway between the side walls, 5 ft. c. to c. On the center piers and parallel with the main walls is a concrete beam 1 ft. wide, reinforced by two rods twisted from steel 1 in. square and running the whole length of the beam. The floor is also of concrete, 4 ins. thick, reinforced by ¼-in. square steel rods, twisted, 2 ins. c. to c., crosswise, and with five running lengthwise, spaced as shown in Fig. 16. The floor slopes 1 in. in 15 ft. toward the center, thus carrying the wash and waste water from the filters into the concrete drains each side of the clear water conduit.

The filters were designed by Mr. C. P. Allen, Chief Engineer of the Citizens' Water Co., who has applied for patents on them. The matter relating to the mechanical filters has been prepared from information furnished us by Mr. W. F. Allen, of Denver.

SEWAGE PURIFICATION IN AMERICA.

(Continued from p. 67.)

Results with Chemical Precipitation at Chautauqua, N. Y.

Samples of crude and purified sewage were taken at the Chautauqua chemical precipitation works (Eng. News, Sept. 21, 1893) on Sept. 25, 1893, and analyzed later by Prof. Maurice Perkins, Schenectady, N. Y. Through the courtesy of Mr. Wm. B. Landreth, M. Am. Soc. C. E., who was the contracting engineer for the plant, the analyses are given below. At the time the analyses were made there was being treated about 125,000 gallons of sewage daily, from some 3,000 people, with 75,000 gallons of ground water included. The pumping records show that the daily pumpage of water at this time was about 20 gallons per capita, which agrees fairly well with the sewage flow, after deducting ground water. At the same time 15 grains of lime, 2½ grains of alum and ¼ grain of copperas per gallon of sewage were being used. The lime used is known as Lighthouse Brand, Marblehead Lime, and comes from Sandusky, O. It was selected after trial of several brands.

The analyses and Professor Perkins' accompanying report are as follows:

(Parts per 100,000.)

	Sewage.	Effluent.	P.c. removed
Appearance	Turbid	Clear	....
Color	Light grayish	None	....
Odor	Urinous	None	....
Total solid residue.	117.	23 6	79.8
Mineral matter (after incineration)	59.2	14.4	75.7
Loss on incineration (organic matter)	57.8	9.2	84.1
Chlorine	6.6129	6.6129	0.0
Corresponding chloride of sodium (common salt)	9.97	9.97	0.0
Free ammonia	2.428	1.3568	44.1
Albuminoid ammonia	2.088	.1856	76.9
Phosphates	Strong reaction	None	....
Nitrates	Not detected	Not detected	....
Nitrites	" "	" "	....

Union College, Schenectady, N. Y., Oct. 8, 1893.
Wm. B. Landreth, Jamestown, N. Y.:

Dear Sir: I have delayed reporting the results of the chemical analysis of the two specimens received Sept. 29, because I wanted to make some observations on them after standing some time. The analyses were made as soon as possible after their receipt. To-day I made another partial analysis of the crude sewage. This was to explain some of the results of the first.

Let me first speak of the treated sewage or effluent. I must congratulate you on your success. This is the first "effluent" that I have ever seen that did not undergo change such as to make it muddy and smell badly. To-day, though the bottle, half full, has been kept in the laboratory, at the ordinary temperature of a room at this period of the year, the fluid is as clear and to the senses as unoffensive as at the first moment of receipt. How thorough the removal of solids and putrescible matter has been you can see by the comparison of the two analyses.

The analysis of the crude sewage shows large quantities of free ammonia. Larger amounts of this than of the albuminoid were present, but in the effluent you will see there was much less ammonia. It would be difficult by any process to remove the ammonia from the crude sewage. So this found in the specimen sent me above that in the effluent must have been formed during the time which elapsed between its collection and my analysis (3 days). When the reagents used in the process struck the original or crude sewage, nearly one-half of the nitrogen which I found in the form of free ammonia must have been in the albuminoid form, and have been precipitated by them. Thus the albuminoid ammonia was removed before change had occurred.

The crude sewage contained some finely divided paper, which of course left an ash on incineration. This in part accounts for the high ash, etc., of the crude sewage. But it is this as well as other materials that you desire to remove by your process.

In conclusion, if you can furnish such an effluent, I do not see how it can become offensive.

Respectfully yours, Maurice Perkins.

The samples were taken at about 4 p. m., in clean bottles, sealed and delivered to the express company by Mr. Landreth, but, unfortunately, they were delayed in transit. The sewage was taken from the main supply channel, at the entrance to the first tank, the lime and alum solutions having been shut off prior to the taking. The effluent was taken at the head of the steps leading to the effluent drain.

Mr. Landreth's contract provided that the effluent should be at all times "clear, odorless, inoffensive to smell and harmless to fish." During the greater part of July experiments were being made with chemicals and the results were not so good as those secured later on. The analysis given in our issue of Sept. 21 was made during the experimental period. From July 28 until Oct. 2, the date of closing the works, Mr. Landreth states that the effluent was apparently as good as at the time of taking the samples, analyses of which are given above. Regarding the results as shown by the above analyses, Mr. Landreth states:

I think the good results obtained were greatly due to the facts: (1) The sewage flow was measured on a weir nearly every hour and the chemicals carefully proportioned thereto, (2) the sewage and chemicals were thoroughly mixed by the centrifugal pump and (3) the tanks were so designed that the course of the sewage in them could be controlled and cross-currents made impossible.

Regarding the cost of operating the plant during the season of 1893 Mr. Landreth states:

From July 1 to Oct. 1, 92 days, the cost for labor was: Superintendent and engineer at $85 per month, $255; helper (105 hours), at 12½ cts. per hour, $131; total, $386. For the 92 days this is a trifle less than $4.20 per day and with an average population furnishing sewage of 4,000, the cost for labor would be a little over 1-10 ct. per capita per day.

Captain Burrows, my superintendent, writes me that the amounts of chemicals used per day (after the ex-

perimental period) average about as follows: Lime, one barrel; alum, 30 to 40 lbs.; copperas, 2 to 5 lbs. The total cost of chemicals will foot up more than is indicated by these quantities, as we used large amounts of them during July in experimenting to find the proper proportions suited to the sewage.

The fuel was wood cut on the Assembly grounds, and I am unable to give the cost, but if coal were used the cost would not exceed 30 cts. per day.

The cost for one day's chemicals, based on the amounts given above and the prices given below, would be about 85 cts. for lime, 75 cts. for alum and 15 cts. for copperas, on the assumption that the prices are for chemicals delivered to the works, or a total of $1.75 per day. On this basis the total cost per day of operating the works would be as follows: Labor, $4.20; fuel, $0.30; chemicals, $1.75; total, $6.25. Assuming the average attendance during the season as 4,000 people, the daily per capita cost of operating the works would be 0.156 ct., at the rate of 57 cts. per capita per year. The cost of the works is not given, so the total per capita expense caused by the works cannot be stated.

For chemicals alone the cost per capita per day, on the above basis, is 0.044 cts., or about 16.1 cts. per year. It must be remembered that the figures for chemicals are based on averages for the season, excluding the experimental period, with a population of 4,000, and therefore cannot be used to judge of the cost per capita of securing the degree of purification shown by the above analysis. The cost of chemicals alone at the time the analyses were made, about 125,000 gallons per day of sewage and ground water then being under treatment, was as follows, again assuming that the cost of chemicals includes freight and cartage to the works.

	Grains per gallon.	Total lbs.	Cost: Per lb., cts.	Cost: Total.	Cost per 1,000,000 gallons.
Lime.....	15	268	0.416	$1.11	$8.88
Alum.....	2¼	45	2.15	.97	7.76
Copperas.....	¼	4	4.	.16	1.28
Totals.....	....	....	... .	$2.24	$17.92

With $2.24 as the total daily cost of chemicals the cost for 3,000 people is 0.0746 ct. per capita, or 27.23 cts. per year, as against 16.1 cts. as the average for the season, after passing the experimental period, or an excess of about 70%. The cost of chemicals per 1,000,000 gallons treated is shown to be $17.92, but in connection with all these figures it must be remembered that the amount of sewage at Chautauqua at the time of the analysis, even when diluted with its bulk of ground water, averaged only about 40 gallons per capita and was therefore very strong. The analysis shows a very strong sewage and Mr. Landreth describes it as "very thick and rank," and states that several persons familiar with the appearance of sewage have pronounced this to be "the rankest they ever saw."

The cost of chemicals, given above, is based on figures from the books of the Chautauqua Assembly, showing the total amount of chemicals bought during the season. The cost per pound has been appended to these figures, as follows:

	Total cost, $.	Cost per lb., cts.
30,000 lbs. lime (150 bbls.).....	126 40	0.416
8,400 lbs. alum.....	180.60	2.15
1 bbl. copperas.....	7.50	4.*
Total.....	$314.60	

* The cost of the copperas per pound is based on a statement by Mr. Landreth that he believed it costs 4 cts. per lb.

There remained over after the works were shut down for the season 500 lbs. of lime and 2,000 lbs. of alum. Deducting the cost of these chemicals there remains $269.52 as the actual amount for chemicals used during the season. As nearly as can be learned, the works were in operation 94 days, which would make the daily cost of chemicals $2.87, but large quantities of chemicals are said to have been used by way of experiment in July, as already stated.

The results of hourly gagings of the flow of sewage on July 24 and 31 and Aug. 16 and 18, 1893, are shown by the accompanying diagram, Fig. 98, which needs no comment. Mr. Samuel M. Gray, M. Am. Soc. C. E., of Providence, R. I., was consulting engineer for the works.

Correction, Marlborough, Mass.

In our issue of Dec. 14, 1893, the area of the filter beds was given as 36.8 acres, which should have been 11.3 acres, the former figure being the area owned by the city.

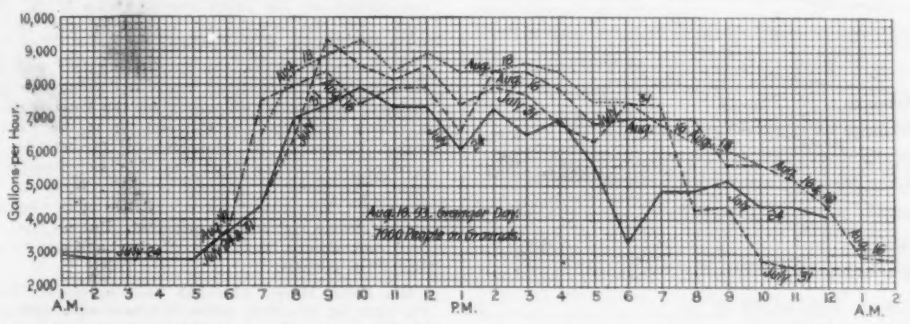


FIG. 98. HOURLY SEWAGE FLOW AT CHAUTAUQUA, N. Y., JULY 24 AND 31, AUG. 16 AND 18, 1894.

METAL UNDERFRAMES FOR RAILWAY CARS.

The question of the use of metal frames for railway cars is one of growing importance in this country, and the great extent to which such construction is used in many foreign countries goes to prove that the metal frames are found to be more economical than the wooden frames. The advantages of steel frames from an economic and practical point of view have been discussed at some length in our issue of May 19, 1892, and illustrations and descriptions of various types of metal framing will be found in our issues of July 11, 1891, June 8 and 22, 1893, and other issues noted below.

In a paper read before the New York Railway Club on Jan. 18, Mr. G. R. Joughins, Superintendent of Motive Power of the Norfolk & Southern R. R., gave an account of his experience with the tubular frame type of car (Eng. News, April 28 and June 16, 1892) and of a special form of car designed by him as a result of such experience. In consequence of the rapid decay of wooden cars in the district through which this road runs, 50 tubular frame flat cars were leased from the Iron Car Co. in August, 1888, for five years. The cars were well designed and well built, put together entirely with bolts and screws, and after five years' service they were in good condition. They showed some defects in general design, however, and while able to stand the shocks of service a few years ago, are not able to stand the more severe shocks due to the use of heavier motive power and improved draft rigging. Being made with only four sills (each composed of two tubes, one over the other, separated by distance pieces), the frames showed far more deflection than frames with wooden sills under similar loads, and while the use of this number of sills was for the purpose of making a light car the arrangement has proved to be a very serious defect. The draft rigging was so constructed that all the pulling strains come directly on the end sills and the buffing strains on the body bolsters, which parts were not made strong enough to sustain end strains, and were a constant source of trouble. The number of special parts also caused difficulty and delay in making repairs. The road being a small one accurate records could be kept of the car repairs, and employees were punished for damage caused by carelessness, etc., while premiums awarded quarterly to the best train hands secured more than usual care in handling. The cars were therefore operated under favorable conditions. They were run in regular service with heavy loads, and in trains of 50 to 60 cars, and the cost for repairs was very small, averaging $1.40 per car per annum, exclusive of wheels and brasses. The following table gives the cost of repairs for 50 wooden frame and 50 iron frame flat cars for the three years April, 1890, to April, 1893, and is an interesting statement of the comparative economy in repairs:

Flat cars.	Wheels and brasses.	Wrecks.	Other repairs.	Total.
50 iron.....	$34.85	$208.00	$165.52	$406.17
50 wooden.....	549.59	1,050.80	2,664.49	4,264.88

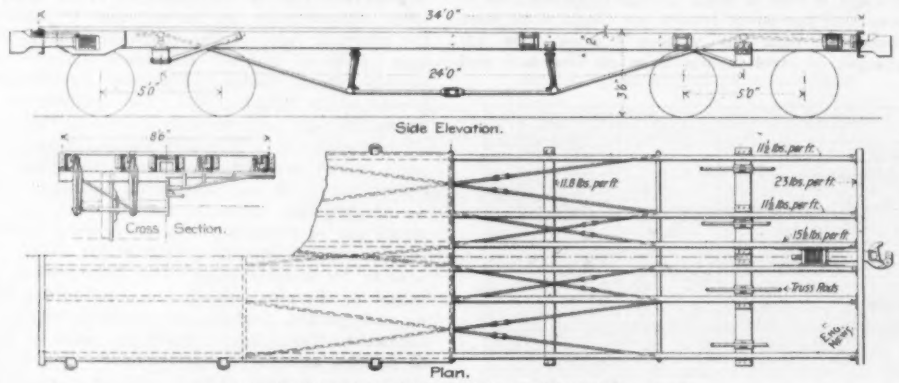
From the experience obtained with these cars, Mr. Joughins designed and built a steel car of heavier and simpler construction. It has six longitudinal sills of 8-in. steel channels, the center sills weighing 15½ lbs. per ft., and the others 11¼ lbs. The draft gear is placed between, and not below, the center sills, and the end sills are 12 ins. deep to allow of a sufficiently large hole for the drawbar. The sills are tied together transversely by bolts having gas pipe distance pieces, and longitudinally by diagonal tie-rods fitted with turnbuckles and having their ends on the transverse bolts. Experiments are to be made to ascertain the practical value of this diagonal bracing. The body bolsters are of the plate pattern, the bottom plates being supported by diagonal braces to the counter sills. The connections between sills and between body bolster and sills are of steel angles 3½ × 3½ × 7-16 ins. and ¾-in. turned bolts. There are four 1⅜-in. truss rods, with the ends upset to 1¾ ins. The needle beams are steel tees 5 × 3½ ins., bolted to the side sills, and the struts are of malleable iron. The truss depth is 21½ ins. below the sills, thus giving great stiffness to the underframing. The draft pockets are bolted to the side sills by ten 1-in. turned bolts to each pocket, forming an unusually strong attachment. The follower plates are made as short as possible and the Pennsylvania R. R. standard draft spring is used, with a supplementary buffing spring behind the horn of the coupler. The platform is made in four lengths, each held in place by six or eight ¾-in. bolts, so that any one may be removed for inspection or repairs of platform or sills.

In the design of this car the following principles were kept in view: 1, the use of common rolled sections and plain forgings; 2, no rivets to be used; 3, no holes to be allowed in the flanges of beams; 4, all work to be equal to locomotive work; 5, the ultimate weight and cost of car to be secondary considerations. The first two of these principles have been followed to some extent in the Harvey steel cars, as the results of practical experience, as noted in our issue of June 8, 1893, but rivets are not entirely abandoned in them, being used for attaching the draft pockets, etc. Mr. Joughins admitted that the trouble of loose rivets due to the vibration would not occur if sufficient rivets could be used, and stated that it is one of the good points of the Fox pressed steel truck that very large joints are made and plenty of rivets used, while in the diamond truck there are not enough rivets to support each other. The bolts are made with a driving fit, as in locomotive work and the Boies steel wheels, and the bolted joints are not only more permanent, but facilitate repairs very considerably. It is also claimed that they make cheaper work as the joints would not require to be so large or the fastenings so numerous. Turned bolts are used, and the part within the bolt holes is not threaded, so that the plates have a full bearing on the bolts. Very reasonable bids have been received by the railway company for the construction of similar cars.

The car was built for a maximum capacity of 80,000 lbs. and was designed to resist the various buffing, corner, torsional and other strains to which it is subjected in ordinary service. Its weight, without brakes, is 20,300 lbs. With a test load of 80,000 lbs. for ten days, the car being moved several times, the sills showed a total deflection of ⅞ in., and a permanent set of ¼ in. A slight deficiency in resistance to torsion was found, however, with heavy loads of pine logs, which wedge themselves down against the stakes and produce

a large twisting force. The car has been in service for about 14 months without any loosening of bolts or any expenditure for repairs.

At the December meeting of the Western Railway Club, a paper on this same subject was presented by Mr. J. D. McIlwain, of the Harvey Steel Car Works, who referred particularly to the Harvey steel cars, which we have already described and illustrated, and also gave particulars of some of the foreign cars exhibited at the Columbian Exposition, and which had sills of steel channels. Many roads in foreign countries have found metal cars more economical than wooden cars, and as the first cost of the former is greater, the economy must be in the maintenance and renewals. He gave the life of American wooden cars at twelve years, and estimated that a steel frame would last four times as long, while the latter would not require the work in taking up slack due to shrinkage which has to be done for the first two or three years with a wooden car. According to M. C. B. rules of depreciation an ordinary car twelve years old costs more for maintenance than it is worth. The question of dead weight is of considerable importance, and a properly designed steel car can be built which will weigh 15% less than a wooden car of the same capacity. Mr. McIlwain referred to the advantage of the use of standard sections of material, and to the use of bolts in preference to rivets, the work being put together like a car, and not like a boiler. He also suggested the use of steel frames for passenger cars, as follows: Two center sills of 12-in. I-beams, six intermediate and side sills of 8-in. I-beams, end sills of 8-in. I-beams, side and end plates of 6-in. I-beams, with eight 3×4-in. angles for corner and end posts, and ⅜×3-in. plates for end braces. Such a structure, properly put together and fitted with the usual buffing attachments, etc., for the vestibule, would reduce the liability of wreck in case of train accidents to a minimum. In conclusion, he stated that the question of the success of metal cars in this country depends largely on the disposition of railway managers and car owners to pay 20% more for new equipment that will reduce the present cost of operation and maintenance 50 to 75%.



STEEL FRAME CAR, NORFOLK & SOUTHERN R. R.
G. R. Joughins, Superintendent of Motive Power.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Right of Village to Use Water.

Where a water company builds a dam and reservoir on a stream for the purpose of supplying the village below with water, but does not acquire any right to the waters above the dam, it is subject to the right of the inhabitants of a village situated above the dam to use the water of the stream, which was their only source for obtaining water, and it cannot enjoin the construction of a dam above its dam for the purpose of supplying such village.—Barre Water Co. v. Carnes, Sup. Ct. of Vt., 27 At. Rep. 609.

Contract for Erection of County Bridges.

Where the cost of a county bridge exceeds $100, contracts for the erection of the same must be let to the lowest bidder, after due advertisement, stating the general character of the work.—State v. Cunningham, Sup. Ct. of Neb., 56 N. W. Rep. 485.

Powers of Commissioners of Electric Subways.

The act of March 10, 1892, creating the board of commissioners of electric subways, does not empower the board to grant to a street railway company the franchise to erect poles and wires in the street to furnish power to propel cars by electricity. The function of the board is merely the supervision of the exercise of franchises derived from other legislative authority. A resolution of the board granting a company permission to construct and maintain electric wires above the surface of the street will operate only to relieve the company from the interdict in the fifth section of the act. Whether acts done by the company under color of the resolution are legal will depend upon whether such acts were lawful, independent of the resolution.—Trustees of Presbyterian Church of Trenton v. State Board of Commissioners of Electric Subways, Sup. Ct. of N. J., 27 At. Rep. 809.

Validity of Street Assessments.

A resolution to pave and curb a street required the city engineer to furnish the council with estimates. The estimates, in addition to the items of paving and curbing, stated, under the head of "grading," that 66 cu. yds. of excavation and 42 cu. yds. of embankment would be required. The grading, if taken from the entire surface of the street, would involve the removal of one and five-sevenths inches in depth, it would be assumed, from the small amount of so-called "grading" required, that the street had been graded, and that the grading mentioned in the estimates was merely the removal of small inequalities in the surface, and therefore an assessment for the paving and curbing was not invalid on the ground that it required grading, which was not mentioned in the resolution.—Williams v. Bisagno, Sup. Ct. of Cal., 34 Pac. Rep. 640.

The New York State Forest Commission, recently appointed, has issued a special report strongly urging a bond issue of $3,000,000 to purchase 1,200,000 acres of land in the Adirondacks and 60,000 acres in the Catskills. The commission states that this action is warranted by the demand for a better preservation of water supply for motive power, for forest sanitariums and summer resorts, and above all for the fostering of the future timber supply. According to the figures given in the report the great forest of Northern New York covers an area of 3,588,803 acres, and the Adirondack Park, or proposed reservation, would contain 2,807,760 acres. Of this latter area over 1½ million acres are in primeval forest and another million acres are "lumbered" forest. The remainder is classified as denuded, burned and waste land, about 82,000 acres in all, and 57,000 acres of water and 65,000 acres improved land. The state now owns 731,459 acres in this forest, of which 551,093 acres are within the limits of the proposed park. The commission estimates the purchasing price at from $1.50 to $4.50 per acre, for the "lumbered" and uncut areas. In the Catskill region there are over 2,200,000 acres of contiguous forests in Ulster, Delaware and Sullivan counties, of which the state owns, in scattered lots, 49,332 acres, principally in Ulster County. The commission advises the purchase of 100,000 acres of this land also.

The Broadway cable line, according to a statement submitted to the state railroad commission by the company shows a gain of 25% in total traffic and a decrease of 20% in the total expenses over last year, when the line was operated by horses; this large gain of 45% having been secured in spite of a general falling off of 10 to 15% in the traffic of most local lines. As we have previously announced, the company offers a premium of $50,000 for any scheme of propulsion suitable for use on its side lines, which is as cheap and effective as the trolley but without its objectionable features, the commission to be the judge and the company to pay for the use of the system at whatever reasonable rates its owners may fix, in addition to the premium offered.

PERSONALS.

Mr. B. R. Morton has been re-elected City Engineer of Newport, Ky.

Mr. Edward W. Lydster has been elected City Engineer of Everett, Mass.

Mr. John T. Windrim has been appointed architect to the Public Buildings Commission of Philadelphia, vice Mr. John Ord.

Mr. Jesse Lightfoot, Chief Engineer of the Philadelphia, Germantown & Norristown R. R., since 1881, died at Germantown, Pa., Jan. 16.

Mr. Charles Daiziel, Superintendent of Water-Works at Charlottetown, P. E. I., has been appointed City Surveyor in addition to his other office.

Mrs. Annie Hayes Goldthwaite, wife of Mr. Francis S. Burrowes, late U. S. Asst. Engineer at Portland, Me., died in Cleveland, O., on Jan. 17.

The address of Mr. Frederick Ballou is wanted by several correspondents. Mr. Ballou, according to press accounts, is engaged in surveying a route for a proposed Florida ship canal.

Mr. W. S. Shields, Title & Trust Bldg., Chicago, has been engaged as Consulting Engineer for the new sewerage system at Huntington, Ind., and to remodel the water-works pumping station at that place.

Mr. T. F. Dunaway, Division Superintendent of the Missouri Pacific R. R., at Osawatomie, Kan., has accepted the position of General Superintendent of the Union Pacific, Denver & Gulf R. R., with headquarters at Denver, Colo.

Mr. C. C. F. Bent, Superintendent of Construction of the Baltimore & Ohio Southwestern R. R., has been appointed Superintendent of the Philadelphia Division of the Baltimore & Ohio R. R., with headquarters at Philadelphia, Pa., vice Mr. J. Van Smith, promoted, to be General Superintendent of the B. & O. R. R. lines west of the Ohio River, with headquarters at Chicago Ill.

Mr. M. Riney has been engaged as Superintendent of Bridges and Buildings of the Madison Division of the Chicago & Northwestern Ry., with headquarters at Baraboo, Wis. He has been actively engaged in erecting bridges, etc., for some years, and had charge of the erection of the dome of the Administration Building, 264 ft. high, at the World's Columbian Exposition. He has, until recently, had charge of the construction of the Third Avenue Cable R. R., New York, and the erection of several bridges for the Rochester Bridge & Iron Works.

M. Bonaparte Wyse, the French engineer who was instrumental in obtaining from the Colombian government the original concession for the Panama Canal, has been suing the official liquidator of the Panama Canal Company, M. Monchicourt, for $200,000 for services in obtaining from Colombia an extension of time. The liquidator claimed that Mr. Wyse did not carry out his mission in accordance with the prescribed terms and refused payment. But on trial the civil courts have lately ordered the liquidator to pay Mr. Wyse $80,000.

Mr. Peter Milne, who has been appointed Water Purveyor of Brooklyn under the new administration, held the same office under Mayor Low and his immediate predecessor. The Purveyor has charge of the extension of water mains and the general distribution of water; and for this work Mr. Milne is exceptionally qualified, being not only an expert hydraulic engineer, but he is also thoroughly familiar with Brooklyn's water supply from its inception to its present date. He figured prominently as an expert in the Long Island Water Supply Co.'s case, in which an attempt to sell the company's works to the city of Brooklyn at an alleged excessive cost has been defeated thus far.

NEW PUBLICATIONS.

ANNUAL REPORTS.—The following city engineers' and other municipal reports have been received, the names given and the reports named being those of city engineers unless otherwise specified. Where the reports contain matter of interest the latter will be abstracted for publication.

Portland, Me., E. C. Jordon. Boston, Mass., Wm. Jackson; also Report Street Department, H. H. Carter, Superintendent. Marlborough, Mass., B. R. Felton. Rockland, Mass., O. H. Tripp. Providence, R. I., J. Herbert Shedd. New Britain, Conn. New London, Conn., Sewer Commissioners, W. H. Richards, Engineer. Binghamton, N. Y., S. E. Monroe, Brooklyn, N. Y., Department City Works, Robt. Van Buren, Engineer. Dunkirk, N. Y., F. A. Dunham. Gloversville, N. Y., E. B. Baker. Syracuse, N. Y., H. C. Allen. East Orange, N. J., Township Report. Passaic, N. J., Colin R. Wise, City Surveyor. Altoona, Pa., Harvey Linton. Erie, Pa., Geo. Platt. Philadelphia, Pa., City Reports, Jas. H. Windrim, Director Public Works. Wilmington, Del., Department of Engineering and Surveying, Geo. H. Baughman, Chief Engineer. Baltimore, Md., Report of City Commissioner, A. E. Smyrk. Chattanooga, Tenn., Board of Public Works, Robt. Hooke. Nashville, Tenn., J. A. Jowett. Canton, O., Sewer Commissioners, also City Officials, L. E. Chapin. Youngstown, O., City Commissioners, Saginaw, Mich., Board of Public Works, Rolla W. Roberts. Milwaukee, Wis., Geo. H. Benzenberg. Superior, Wis., A. P. Cooper, Burlington, Ia., Wm. Steyth, Davenport, Ia., Thos. Murray. Duluth, Minn., Board of Public Works, David A. Reed, Acting City Engineer. Winona, Minn., F. H. Pickles. Omaha, Neb., Andrew Rosewater. Kansas City, Mo., Board of Public Works, H. P. Langworthy, Secretary. Denver, Colo., J. S. Hunter. Seattle, Wash., R. H. Thomson. Tacoma,

Wash., Board of Public Works, Jas. M. Morrison. Montreal, P. Q., Percival W. St. George. Toronto, Ont., E. H. Keating.

AMERICAN INTERNATIONAL ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.—Proceedings of the Third Annual Meeting, held at Philadelphia, Pa., Oct. 17, 18 and 19, 1893. Secretary, S. F. Patterson, C. & M. Ry., Concord, N. H. 8vo; pp. 100; illustrated.

The subjects reported upon and discussed included "Surface Cattle Guards," "Framing and Protection of Wooden Bridges Against Fire and Decay," "Pile and Trestle Bridges," "Water Columns," "Turntables," "Coaling Stations," "Creeping of Rails," "Wood, Combination and Iron Bridges," "Platforms" "Guard Rails on Bridges" and "Elevating Track for Curves on Bridges." The latter is quite complete, showing various methods of carrying out superelevation on bridges. In addition to the report of proceedings there are seven papers on "The Duties and Knowledge Required of a Superintendent of Bridges and Buildings in the Railway Service," which were presented in competition for a prize.

HELICAL GEARS; A PRACTICAL TREATISE. By a Foreman Pattern-Maker. New York: Macmillan & Co. 12mo; 123 pp.; 101 illustrations; $2.

The author of this work, who has already published many articles upon pattern-making, iron founding, toothed gear construction, etc., here endeavors to supply a gap in technical literature by the production of what is claimed to be the first treatise ever published upon this subject. Starting with the conviction that about one-half of the so-called helical gears are incorrectly made, he proceeds to give what he believes to be the "true and only workable" methods of developing spur and bevel helical wheels. After several well written chapters discussing the friction of ordinary gears and the relation of the helix to helical gears, he proceeds to describe and illustrate his methods for developing almost every conceivable kind of helical gear and for constructing the patterns required. There is very little theory in the work; plainly figured diagrams and clearly expressed text tell the pattern-maker just what to do to obtain desired results.

THE INVENTIONS, RESEARCHES AND WRITINGS OF NIKOLA TESLA, with Special Reference to His Work in Polyphase Currents and High Potential Lighting, by Thomas Commerford Martin, Editor of the "Electrical Engineer," Past-President American Institute Electrical Engineers. New York: "The Electrical Engineer." 8vo; cloth; pp. 496; 313 illustrations; $4.

The enormous and rapid advance which the present years are witnessing in the science of electricity is due, in large measure, to the genius and industry of a limited group of scientists and inventors, among whom the most conspicuous figure is the young man whose work is the subject of this volume.

In Part I. of the book is collected the record of Mr. Tesla's early work on motors, dynamos and other electrical machinery. Part II. describes the experiments with alternating currents of high frequency and high potential, and gives in full the famous lectures delivered by the inventor at New York, London, Philadelphia and St. Louis. Part III. describes miscellaneous inventions and writings, and an appendix describes Mr. Tesla's personal exhibit at the World's Fair and his mechanical and electrical oscillators.

SOCIETY PROCEEDINGS.

WESTERN WATER-WORKS CONTRACTORS' ASSOCIATION.—A permanent organization was effected at Cincinnati, O., recently, and will hold its first meeting on Feb. 1 at Columbus, O. President, R. B. Crothers, Newport, Ky.; Secretary, F. B. Leopold, Cincinnati, O.

PENNSYLVANIA STATE SANITARY CONVENTION.—At a meeting held Jan. 26 and 27 a paper was presented by Mr. Howard Murphy, of Philadephia, engineer member of the State Board of Health, on "Sanitary Engineering, or the prevention of Preventable Diseases." Mr. Jas. H. Harlan, M. Am. Soc. C. E., of Pittsburg, called attention to the effect of wattr purification upon the reduction of the typhoid fever death rate.

CENTRAL RAILWAY CLUB.—The annual meeting was held on Jan. 24. The secretary's report showed a total membership of 193 and $700 cash in the treasury. A report on the maintenance of air-brakes was read by Mr. J. A. Chubb, and a special committee reported on leaky boiler flues. The last-named report ascribed leaky tubes to bad water, poor circulation and sudden cooling of the tubes by air entering the furnace door. In setting flues the committee favored the use of copper ferrules in the smokebox end. The following officers were elected for the ensuing year: President, A. M. Waitt; Vice-President, S. Higgins; Secretary and Treasurer, S. W. Spear; Assistant Secretary, Harry D. Vought; Executive and Financial Committee, A. M. Waitt, T. A. Bissell, George W. West, John D. Campbell, C. E. Rood, O. P. Letcrworth, P. H. Griffin.

ENGINEERS' CLUB OF CINCINNATI.—The sixth annual meeting of the club was held on the evening of Dec. 21, 1893, with 37 members and a number of visitors present. The report of the secretary and treasurer for the fiscal year just ended showed the club to be in a fairly flourishing condition. Ten meetings were held during the year, with an average attendance of 24. Nine new members were added, making the membership 115. The officers elected for the ensuing year were as follows: President, W. B. Ruggles; Vice-President, H. J. Stanley; Directors, Chas. A. Ewing, R. L. Engle and C. E. Lindsay; Secretary and Treasurer, J. F. Wilson. The retiring President, Col. Latham Anderson, addressed the club on the subject of engineering progress during the past year.

ENGINEERS' CLUB OF PHILADELPHIA.—Sixteenth annual meeting, Jan. 20, 1894; President Birkinbine in the chair and 67 members present. The board of directors for 1893 reported 18 regular meetings of the club, with an average attendance of 40, maximum of 68 and minimum of 32 members present during the year. The actual amount of money received from dues, initiation fees, advertisements, etc., was $4,447.36, and the annual expenses amounted to $4,751.21. A careful estimate of the probable income for 1894 foots up to $5,875. On Dec. 31, 1893, the membership included one honorary member, 434 active members and 17 associate members, or 452 in all. Of this number 284 members are classed as resident. The annual address was delivered by Mr. John Birkinbine, his subject being the large manufacturing and industrial interests of Philadelphia, and the advantages of having such an organization as the Engineers' Club located in that city. The officers elected for 1894 were as follows: President, John C. Trautwine, Jr.; Vice-President; A. Falkenau; Secretary, L. F. Rondinella; Treasurer, George T. Gwilliam; Directors, Edward K. Landis, Silas G. Comfort, Charles L. Prince, Strickland L. Kneass, Secretary pro tem.

ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS.—The ninth annual meeting was held at the University of Illinois, Champaign, Jan. 24 to 26. President S. S. Greeley, of Chicago, in the chair. The first paper was by Mr. Emil Rudolph, of Chicago, entitled "What Can be Done to Elevate the Standard of the Surveying Profession?" in which he advocated a law requiring surveyors to have a license, and later the society voted to present again the bill for that purpose printed in the second annual report of the society. Mr. W. A. Darling, City Engineer, of Rock Island, gave "A Sketch of the Paving Operations in Rock Island." The pavements laid consisted of two courses of brick on sand, or one course of brick on macadam, or one course of brick on native gravel. Mr. T. S. McClanahan, City Engineer, of Monmouth, described the sewerage system constructed by him last summer. Monmouth has 13 miles of sewers, but no method of sewage disposal. All expenses for sewers and pavements are assessed against private property. The town has 8,000 population and has expended $210,000 for pavements and sewers during the last 18 months. Mr. E. M. Benson, Champaign, late of the Northern Pacific R. R., gave an account of "Cribs and Retaining Walls" employed in northern Idaho. Mr. C. E. Ellsworth, of Danville, sent a paper on "Platting Town Lots." Prof. A. N. Talbot, Professor of Municipal Engineering, University of Illinois, read a carefully prepared and valuable paper on "The Determination of the Amount of Storm Water in the Design of a Sewerage System." Mr. J. W. Alvord, of the Department of Grades and Surveys of the World's Columbian Exposition, sent a humorous and entertaining article on "Methods of Driving Stakes." Mr. W. D. Pence, Instructor in Civil Engineering, of Champaign, gave an instructive account of "Experience with Creeping Rails on a Trestle at Galveston, Tex."

The President, as his annual address, presented the supposititious address of the president of the society in 1944. Mr. Daniel Gordon, of Moline, sent a paper on "The Construction of Water Powers on Large Rivers," and Mr. D. L. Brancher sent a paper entitled "What I Do Not Know vs. What I Do Know." Prof. Ira O. Baker, Champaign, under the head "Mechanical Aids in Computing," called attention to special features of several logarithmic tables, Norris' and Crelle's multiplication tables, Mannheim's and Thacher's slide rules, and Thomas' arithmometer. Mr. W. F. Kendall, of Champaign, recently assistant engineer on the Pecos viaduct, read a paper on "Bridge Erection," describing the usual methods employed by American engineers. Mr. D. W. Mead, of Rockford, presented a lengthy but very interesting paper on "The Historical Geology of Illinois." Prof. L. P. Breckenridge, Professor of Mechanical Engineering, University of Illinois, explained his method of "Indexing and Filing Engineering Literature." He said that the scrap book method was the worst that could be devised, and was worse than useless, and advocated the envelop system for notes and clippings. Arthur Lagrou, City Engineer, of Freeport, presented a paper on "Roads and Road-Making." Mr. F. S. Balcom, Assistant Engineer of the C., C., C. & St. L. R. R., read a paper on "The Transportation Problem of the Future." Mr. Jas. M. White, Asst. Prof. of Architecture, University of Illinois, presented an interesting and instructive paper entitled "The Efficiency of Insensible Ventilation of Dwellings," being chiefly an account of experiments. Mr. Edwin A. Hill, Assist. General Manager of the Jacksonville & Southeastern R. R., made some valuable suggestions concerning the preservation of data on "The Cost of the Work." Mr. P. Mogensen, of Champaign, gave an interesting account of nine years' experiences as an engineer in South America. Mr. E. I. Cantine described the methods employed in constructing the foundations for an extensive viaduct in northern Idaho. Mr. N. Clifford Ricker, Professor of Architecture, University of Illinois, explained four planimeters, and gave an account of a series of tests he had made to determine the accuracy of each under different conditions, obtaining a higher degree of accuracy than any on record.

The reports of the several standing committees were, for lack of time, read by title and ordered printed. The topical discussions were not taken up. The following officers were elected for the ensuing year: President, D. W. Mead, Rockford; Vice-President, T. S. McClanahan, Monmouth; Executive Secretary and Treasurer, J. A. Harman, Peoria; Recording Secretary, W. D. Pence, Champaign. Members of the Executive Board, S. S. Greeley, Chicago; S. A. Bullard, Springfield; F. S. Balcom, Mt. Carmel. The next meeting will be held at Monmouth the last week in January, 1895.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF PHILADELPHIA.
Feb. 3. Secy., L. F. Rondinella, 1122 Girard St.

SWEDISH ENGINEERS' CLUB.
Feb. 3. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Ericson.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Feb. 5. Secy., C. L. Annan, City Engineer's Office.

BOSTON SOCIETY OF CIVIL ENGINEERS.
Feb. 6. "Work of a City Engineer's Office." Secy., S. E. Tinkham, 36 Bromfield St.

ENGINEERS' SOCIETY OF PHOENIXVILLE.
Feb. 6 Secy., W. Halliburton.

ENGINEERS' CLUB OF ST. LOUIS.
Feb. 7. Secy., Wm. H. Bryan, Historical Soc. Bldg.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Feb 7. Secy., F. Collingwood, 127 E. 23d St., New York.

WESTERN SOCIETY OF ENGINEERS.
Feb. 7. Secy., J. W. Weston, Lakeside Bldg., Chicago.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Feb 8. Secy., C. H. McLeod, Montreal, P. Q.

ENGINEERING ASSOCIATION OF THE SOUTH.
Feb. 8. Secy., Hunter McDonald, Nashville, Tenn.

ENGINEERS' AND ARCH'TS CLUB OF LOUISVILLE.
Feb 8. Secy., F. W. Mowbray, Norton Building.

NORTHWESTERN TRACK AND BRIDGE ASS'N.
Feb. 9. Secy., D. W. Meeker, St. Paul.

MONTANA SOCIETY OF CIVIL ENGINEERS.
Feb. 10. Secy., G. O. Foss, Helena.

ENGINEERS' CLUB OF KANSAS CITY.
Feb. 12. Secy., Waterman Stone, Baird Building.

WISCONSIN POLYTECHNIC SOCIETY.
Feb. 12. Secy., M. F. Schinke, City Hall, Milwaukee.

AMERICAN INSTITUTE OF MINING ENGINEERS.
Feb. 12, 13. Virginia Beach, Va. Secy., R. W. Raymond 13 Burling Slip, New York.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
Feb. 13. Secy., F. C. Osborn, Case Library Building.

NORTHWEST RAILROAD CLUB.
Feb. 13. Secy., W. D. Crosman, Ryan Hotel, St. Paul.

NORTHWESTERN SOCIETY OF ENGINEERS.
Feb. 13. Secy., D. W. McMorris, Burke Block, Seattle Wash.

DENVER SOCIETY OF CIVIL ENGINEERS.
Feb. 13. Secy., F. E. King, Jacobson Block.

CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Feb. 14. Wichita, Kan.

NEW ENGLAND RAILROAD CLUB.
Feb. 14. Secy., F. M. Curtis, P. O. Box 1576, Boston.

AMERICAN SOC. OF MECHANICAL ENGINEERS.
Feb. 14. Secy., F. R. Hutton, 12 W. 31st St., New York.

ENGINEERS' CLUB OF CINCINNATI.
Feb. 15. J. F. Wilson, 24 W. 4th St.

NEW YORK RAILROAD CLUB.
Feb. 15. Secy., John A. Hill, Temple Court.

SCANDINAVIAN ENGINEERING SOC. OF CHICAGO.
Feb. 15. Secy., Howard Berge, 100 Washington St.

TACOMA SOC. OF ENGINEERS AND ARCHITECTS.
Feb. 16. 201 Washington Building.

ENGINEERS' CLUB OF MINNEAPOLIS.
Feb. 19. Secy., E. Nexsen, 504 Kasota Block.

ENGINEERS' SOC. OF WESTERN PENNSYLVANIA.
Feb. 20. Secy., R. H. Clark, Pittsburg.

WESTERN RAILWAY CLUB.
Feb. 20. Secy., Clement F. Street, Rookery, Chicago.

COLUMBIAN ENGINEERING SOCIETY.
Feb. 20. Secy., F. W. Hart, Washington, D. C.

ASSOCIATION OF ENGINEERS OF VIRGINIA.
Feb. 21. Secy., L. J. Carmait, Roanoke, Va.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
March 2. Secy., E. K. Smoot, 803 Commerce St.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
March 2. Secy., O. Von Geldern, 719 Market St., San Francisco.

CENTRAL RAILWAY CLUB.
March 28. Secy., S. W. Spear, Buffalo, N. Y.

AMERICAN RAILWAY ASSOCIATION.
April 11. Secy., W. F. Allen, 24 Park Place, New York.

SOUTHERN & SOUTHWESTERN RAILWAY CLUB.
April 19. Secy., S. A. Charoiot, Macon, Ga.

MASTER CAR BUILDERS' ASSOCIATION.
June 12, 16. Saratoga, N. Y. Secy., J. W. Cloud, Rookery Building Chicago.

MASTER MECHANICS' ASSOCIATION.
June 19, 23. Saratoga, N. Y. Secy., Angus Sinclair Temple Court, New York.

ENGINEERING NEWS

AND

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ADVERTISING RATES: 20 cents per line agate measure. Want notices, special rates, see page 22. Rates for standing advertisements sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

The selection of engineers to fill the important position of commissioner of public works, or the same office under some other name, was very ably advocated at Philadelphia last week before the national conference on municipal government by the well known civil service reformer, Mr. Carl Schurz. That part of Mr. Schurz's address relating to this subject is reprinted elsewhere in this issue. The main point of Mr. Schurz's argument is that the engineer should be selected because of his fitness for the position through his knowledge of engineering. That a business man is required for the mere sake of executive ability the speaker said he did not believe, and stated that "among civil engineers executive ability is probably as abundantly found as among any other class of persons." With this opinion we most heartily agree, and doubtless most, if not all, of our readers will be of the same mind. Another strong point in the address was that the engineer has a professional reputation to maintain and therefore is more likely than an ordinary business man to keep clear of politics, in the baser sense of the word. This also agrees with the common observation of those who have a large acquaintance among engineers. The interest which of late is developing among reformers regarding municipal affairs is gratifying and promises well for the interests of the profession. As time goes on we trust that fewer and fewer engineers will have occasion to say, as did an engineer in a letter to this journal some time since, "city engineers propose, but city councils dispose," referring to the partial failure of a good engineering project because of adverse action by the city fathers.

The new Boston Subway Commission, as will be seen from a news note in another column, is so favorably impressed with the advantages of the proposed subway that it has applied to the legislature to increase the total length and cost of the structure as now authorized nearly threefold before starting on construction. All reports from Boston indicate that the commission is taking hold of its work in earnest and with the sole end of doing the best for the city possible, which is in itself a gratifying thing in these days of bad city government. There can be no doubt also that the commission is entirely right in its view that the symmetry of the work requires this extension instead of stopping it short at Scollay Square in the very heart of the city; but, on the other hand, there is this to consider. The first piece of subway built, whatever its length, will be regarded either as a success or a failure. If a success, there can be no rational doubt that even the complete structure as now proposed will not more than half suffice for the needs of the city. If regarded as a failure, then, of course, the less built the better. Whether regarded as a success or a failure as a whole, the work will be an entire novelty, all the details of which have had to be evolved without precedents. In all such cases it is quite certain that there will be some failures of detail in the plan; some things that, if they were to be done over again, would be done differently and better. Superhuman prescience is not to be had by any commission. From this point of view the question cannot but arise: Supposing the commission to have now at its command an appropriation of $20,000,000 with authority to build ten miles or more of subways in which it heartily believed; what would be the part of wisdom? Would it not be to build a short section first, so that the whole city might learn to share its faith, and it might learn by experience and further study just what were the best plans and routes before it finally committed itself to any one? It strikes us so, especially as the utility of the work is so largely dependent on correctness of detail; nor does it necessarily follow that the completion of the entire work would be much postponed. We trust the commission will get the authority it desires, for the good of the city, but we also hope that it will think twice before using it at once. In attempting any work of which every detail will be novel, "Be bold, Be bold, Be not too bold," is always good advice.

The bill in favor of governmental aid to the Nicaragua Canal which Senator Morgan has introduced in effect takes the canal entirely out of private hands and makes it a government work, the government having 10 of the 15 directors as well as 70% of the stock. We are heartily and emphatically in favor of governmental aid to and supervision of this work, as our readers know, and would vastly rather see this bill pass than none at all. The good of every part of the country demands the early construction of the work, and its cost would be but a small fraction of its value if built solely at public cost and operated at the lowest possible tolls which would pay interest on that cost, at least for American shipping. And yet the provisions of the bill seem to us in many respects unfortunate. If the government has direct control of the work, as this bill in effect provides, the cost of construction is almost sure to be unreasonably and unnecessarily great both in time and money, not because the men in whose charge it will be will be necessarily less able or less zealous (though they are likely to), but from the very nature of such control, which cramps all originality, enterprise and technical independence. In a work of this kind the element of deep personal interest in the quickness and cheapness of construction cannot safely be eliminated, though it may well be regulated and controled. On the other hand, after the canal is once built, then its management sinks into mere administrative routine, for which government management is well suited and efficient, while the stimulus of private interest then becomes wholly evil in its effect, keeping up tolls, but not tending in any sensible degree to higher efficiency.

Under these circumstances the just and expedient method of extending government aid to the enterprise would seem to be this, keeping also in mind the fact that the stockholders and officers of the present company have rendered a great public service at considerable risk in bringing the enterprise to its present state, and hence are entitled in equity to get something besides their money back, or at least to an opportunity to do so by good management:

The government should carefully avoid all direct control or responsibility for the work of construction unless the cost should exceed a certain reasonable maximum, or be in danger of doing so in the judgment of its own engineers. The general effect of the bill, whatever its precise form, should be to guarantee the bonds of the company in return for full potential government control of the enterprise in case of any default, but it should say in effect to the company: We allow you to build this canal in your own way, subject to the inspection and veto of our inspecting officers in case of obvious improprieties, and we allow you —— dollars and —— years to do this in. If you build it for less money, a goodly fraction of what you save out of this sum shall go to you as compensation for services and profit. If you build it in less time, each year saved shall be regarded as the equivalent of —— dollars saved in cost. If you exceed these limits you shall get nothing, but the government will itself assume control of and finish the canal, as it will in any case as soon as the canal is finished and opened to traffic.

The difference between these two plans in a nutshell is this: In the one case all those in authority over the work have a strong personal interest in doing the work quickly and cheaply; in the other case, none of those in authority have such interest. In each case alike government engineers and officers are at all times in full ultimate control of the work, but in the one case they will do nothing unless they feel perfectly sure it is right, however much it may promise to expedite or cheapen the work, while in the other case, they will interfere with nothing unless they are perfectly sure it is wrong and will injure or delay the work. This latter authority the government engineers are well suited to exercise wisely. The other kind of authority, which involves alert initiative under novel conditions, they are ill-suited to exercise.

Purdue University had just finished and dedicated on Jan. 19 a new mechanical laboratory at a cost of $100,000, filled with mechanical plant worth over $70,000 more, among which was the only experimental locomotive in the country. Only four days later the building caught fire and was totally destroyed, there being a salvage of but $45,000 from insurance. It will not be disputed that in this particular instance it would have been a blessing in disguise to the university had timber been so costly that fireproof construction would have been forced upon it. The cost of the building would have been perhaps one-third greater if of the best fireproof construction, or possibly one-sixth greater if of slow-burning construction, and it might have been a little harder to raise the money. Still, how much better to have waited two or three years until they could put up a building which would be good for a century, rather than have put up one in haste to be burned up and rebuilt at leisure, and so on indefintely! It is this point of view which makes us look with equanimity on the reckless waste of our timber supply, as one might watch with equanimity a drunkard getting away with a strictly limited supply of whisky. Rightly used, this supply might prove in either case a lasting blessing instead of a temporary curse, but there being no hope of making the victim of his own folly see this, it is for his own good in the end that he should make away with his tempter as soon and as wastefully as possible. No other country on earth makes such excessive use of timber for building as this. No other has any approach to such a frightful fire-loss, which now approximates $150,000,000 yearly, to which may be added at least $50,000,000 for the cost of running fire departments and insurance companies and for the money value of indirect losses. The capital sum corresponding at 5% to $200,000,000 yearly is $4,000,000,000, which may be something like one-fifth of the value of all our buildings. It simply does not pay to use cheap combustible materials instead of dearer incombustible, at least in large important buildings and in large cities; but the yearning for immediate cheapness at whatever risk is so strong that it is not likely to be overcome until the temptation to this course is removed. It would be wiser and cheaper in the end to burn the timber in the forest, before human labor has been expended on it, to go up in smoke with it, rather than abuse its use as our people now do.

We alluded recently to the contrast between the British and American naval service in respect to treatment of engineers. The following compara-

tive figures will show, first, the absurd contrast which exists even in our service, in view of the comparative importance and difficulty of the work of the line and the engineering staff on the modern warship, between the financial and other compensations for such service; and, secondly, the vastly greater contrast in this respect in the British service. We should mention that the pay of our "engine-room artificers" (machinists) is recognized as too low in proportion and is likely to be increased.

Average Rates of Pay for Various Naval Grades.

	British.	American.
Admiral (16,600 to 19,300)	$17,450	(formerly $13,000)
Rear Admiral (8,000 to 13,300)	10,650	6,000
Captain (2,430 to 3,370)	2,900	4,500
Lieutenant (974 to 1,180)	1,027	(2,400 to 2,600) 2,500
Chief Engineer (1,240 to 2,030)	1,640	(2 800 to 4 200) 3,500
Engineer (885 to 1,155)	1,020	(2,000 to 2,700) 2,350
Asst. Engineer (622 to 754)	688	(1,700 to 1,900) 1,800
Eng. room artif. (467 to 667)	567	840
Carpenter, etc. (186 to 739)	608	(1,200 to 1,800) 1,500

The American pay is given without adding any of the allowances, which are very small, about $9 per month, or one ration.

The British pay includes the minimum allowance for extras, which allowance is always given, but not the maximum allowances, which are given on certain ships and stations only.

In both services carpenter, the boatswain, gunner and sailmaker are paid the same. The British assistant engineer averages $80 per year only more than these officers, and the highest pay to which he can ever attain if he gets to be chief engineer is that of navigating lieutenant (£401 and extras), between which latter grade and captain there are the two grades of commander and staff-commander. In our service, an assistant engineer starts in at considerably higher pay than the average for a chief engineer in the British Navy, and his final limit as a chief engineer is within a fraction of a captain's pay.

THE OFFICE OF CITY ENGINEER.

The one conspicuous failure of American institutions, so far, lies by general admission in the government of cities. Our national government, with all its undoubted defects of detail and minor abuses, like the still existing remnants of the spoils system, is probably as honestly and effectively administered as any other in the world in the essential respects of quantity and quality of service obtained in return for its expenditures, and of integrity, competency and fidelity of its officials. As compared with any of the independent governments of the English-speaking race, at any rate, we are confident that the United States government in the aggregate is distinctly superior to any of them in the essentials of freedom from jobbery and manipulation of public business for private ends. The American habit of free public criticism of all public officials misleads people—especially those who are not unwilling to be misled. This habit is a sign of health and not of disease. Our national government as a whole is a superb machine. There is none better.

Our state governments are also much better than they are painted. They are undeniably economical and thrifty. People forget that there are nearly 50, and that a lynx-eyed press spreads every scandal on mere suspicion; and yet, there are only a few which are ever attacked for worse than bad judgment. Judged by results they work well. Our small town governments are also something of which we may be justly proud. They are not only unique in kind, but almost invariably admirable.

But the government of our cities is nearly always bad, and grows worse and worse as we rise to larger and larger cities. On the other hand, in Great Britain and on the continent the city governments are practically the best of all, and such a thing as bad city government is practically unknown. When an American reads or sees how these cities are kept clean and well paved, how city transit franchises are made to give revenue to the public, how every passenger is invariably provided with a seat, how quickly and cheaply great public improvements are carried through by public officials at the public cost without any breath of scandal; how the faithful city officer is invariably retained during good behavior and efficiency insisted on; how the number and pay of officials is kept down to that really necessary for good service; the American who sees all this must blush for shame at the contrast, and if he makes any effort to see it, he cannot fail to do so.

One reason for this contrast, beyond doubt, is that this is a period of such enormous material expansion and such enormous growth of cities. Another is the large unassimilated foreign element which chiefly congregates in large cities and is manipulated for private ends. We have no wish to exaggerate; but these explanations only go a little way; because foreign cities also have been growing phenomenally, and yet are well governed; while those American cities in which the foreign element is small are not conspicuously better governed than those of equal size in which it is large.

The fundamental reason for the contrast, and the all-sufficient explanation of it, beyond much doubt, is this: Government of cities, when properly managed, is a purely business matter; politics have no more legitimate relation to it than to the management of a shoeshop. Foreign cities fully recognize and act on this principle, and by their political conditions are enabled to do so. American cities do not recognize nor act on this principle, and by their political conditions find it very difficult to do so. The intensity of national politics is such that it first spreads into and pervades all state elections, though the only legitimate reason for its doing so lies in the election of senators, and from that spreads into and pervades all city elections, where its presence is utterly irrational and absurd. A race of cormorants which fattens on these conditions does its utmost to perpetuate and extend it. The many faithful officials in the service of cities who suffer by it can do little to oppose it, and they take their official life in their hands when they even venture to ignore it or fail to assist it.

No office in the service of cities suffers more from these conditions than that of city engineer, or its equivalent, by whatever name it may be called. In any rationally organized city that office should be and is one of the most important in the whole city, because nearly all the important legitimate work of a city government, outside of the police and fire departments, comes more or less within the proper scope of such an officer. In fact, so manifold and important are the duties which naturally fall upon that office that in all foreign cities and all large cities the office is subdivided and its duties placed upon a number of officials who in foreign cities are nearly always engineers by training and experience and who practically hold a life office. Here, the natural importance of the office is such that it nearly always exists, but the scurvy politicians who "run" the cities have done their best in most cases, first, to strip the office of all independence of tenure, and, secondly, to strip it of its most useful functions, those, namely, by which it may exercise some control upon "patronage" in the public interest.

For, if anything is well settled by experience, it is that permanent salaried officers having the power can and will exercise such control faithfully, while amorphous and shifting elective bodies can't and won't. Alone of all our cities St. Louis once recognized this principle in all its fullness, and had a city government which in all its administro-constructive details was exclusively in the hands of engineers. As a consequence it had for many years a nearly perfect city government, beyond any breath of suspicion. It was too good for the city and they have to a large extent returned to the old system; but enough of its effect still remains to give the city exceptionally good government. In many of our smaller cities much the same conditions exist to-day. In all of them, so far as we have ever learned, the administration of the duties which the politicians consent to leave with the city's engineers is the least criticised and criticisable of all the city's departments. There are doubtless exceptions, but the strongest tribute to their general fidelity, it seems to us, is the all but universal desire of the politicians to strip the office of its natural authority rather than to confer more power upon it. Were they an easily manipulated or corrupted class of men, there would be a strong contrary tendency.

We have thought that it might serve a useful purpose for many reasons to collect some of the facts in regard to the men who are filling these city offices; showing what their qualifications and tenure are and how they are appointed. The first installment of this information is presented in a supplement to this issue, in a series of brief professional biographies of 89 of these city engineers. The list is great enough in itself to be a fair sample of the whole body, since it is a purely chance collection from a considerably larger number which have been received and will appear in due time. A blank asking for this information has been sent to every city engineer in the country known to us; but if any have failed to receive this blank or have lost it, we hope they will take pains to ask for another, and the considerable number who must still have the blank but have failed to send it in will confer a great favor by doing so at once.

We shall not attempt to analyze these records fully until more are before the reader, but a few facts from those which appear this week will be of interest. That the list is fairly representative will appear from the following little table of the cities represented in it:

Sections.	No. states.	No. cities.
New England	3	7
Middle	4	24
Southern	9	16
North Central	8	32
Far Western	5	10
Total	29	89

Let us first see what the showing is in regard to method of election or appointment. One gratifying fact is that out of all the 89 cities represented only one city engineer is elected by "the people," doubtless the worst of all possible ways for choosing a technical officer. But the next worst is probably election by the city council only, and that, according to our returns, is by far the most common mode. In some respects these returns may be defective, as, for instance, in failing to note that the mayor nominates and the council only confirms, but in the main they must be correct, and they stand as follows:

Appointed by the city council only	55
Nominated by mayor and confirmed by council	15
Appointed by the mayor	7
Appointed by some board of public works	9
Appointed by "Chief of Public Works"	1
Elected by the people	1
Unstated	1
Total	89

The best method of appointment, beyond doubt, is by a board of public works when such exists, or otherwise by the mayor. Responsibility for the quality of the appointment is thus concentrated, and jobbery discouraged. Of these there are only 17 out of 89, or about 20%; but there are nearly as many more (15) nominated by the mayor, whose confirmation is doubtless in many cases a mere matter of form, so that there may be considered to be 32 out of 89 who are rationably appointed, or 36%. If we had a better class of men in our city councils, of course, the difference would not matter, but as it is, it is unfortunate.

Next, as to the tenure of office. The proper way, of course, in that as in all other purely administrative offices, is that there should be no particular tenure of office, for stipulating any fixed term whatever is merely providing an easy way for turning a man out without scandal, whether he is efficient or not. Naturally, this kind of tenure is the least favored; there are only 10 out of 89. The worst of all fixed terms, if there must be a fixed term at all, is for only one year; because that keeps a man perpetually on the tenter-hooks of anxiety for his bread and butter, obliges him to keep an eye out always for "influoance," and hence to keep on the right side of the council, whatever else he does. This is precisely what the politicians want, and naturally therefore it is the most favored. An even half adopt it. The full list is as follows:

Appointed for one year only	44
Appointed for two years	19
Appointed for three years	13
Appointed for four years	2
Appointed for good behavior	10
Unstated	1
Total	89

The rule is that the appointments for the most objectionable term, one year, are also made in the most objectionable way, by the council only. There are no less than 31 out of the 89 cases which present this combination, leaving only 13 cases in which any other body but a city council appoints

for so little as one year, and only 24 cases in which a city council appoints for more than one year. This is worth showing in tabular form:

	By city council.	Otherwise.	Total.
Appointed for one year only.....	31	13	44
Appointed for more than one year	24	20	44
Total	55	33	88

The tendency of the popular body to disregard the public interest in its own, by making the city engineer its creature so far as it can, is evident.

Let us now see what the actual tenure of office usually is. Of the 89 men who were actually in office when these returns were made out, no less than 31, or 35%, were then serving their first year or were just past it; 12 had served two years; 17 three years, and 11 four years, making 43 in all (say half), who had served two years or less, and 60 in all (say two-thirds) who had served three years or less. Only 8 out of 89 had served 10 years or more, and only 18, or 20%, had served five years or more

Analyzed by method of appointment there is a slight tendency to more frequent changes when the method of appointment is by the council, as might be expected; but it is only slight; not enough to found any conclusions on. The tendency to frequent changes is apparent enough, but on the other hand, it is to be remembered that in a large fraction of such cases the change is by desire of the city engineer himself. All engineers keep their eyes out for more desirable engagements and frequently find them under existing conditions. The time has not yet come when any considerable fraction of American engineers find it worth their while to stay in one place for life, even when they have the opportunity.

Now, with reference to the personnel of these offices. The ages of the several incumbents vary as follows:

Under 25	1
25 to 30	22
30 to 35	21
35 to 40	14
40 to 45	10
45 to 50	11
50 to 60	3
60 to 70	5
Over 70	1
	88

An even half of the incumbents, lacking one, are between 25 and 35, averaging 30 years of age. A little over one-fourth of all are between 35 and 45.

In respect to technical education the showing is very gratifying, considering that it is not more than 20 years since engineering schools became at all common. No less than 49 out of 89 are college graduates, all but two or three of them being graduates from engineering schools, and a large proportion for the remaining 40 had an academic or high-school education before beginning practice. This is a far higher proportion of college graduates than the American Society of Civil Engineers shows, and the Institution of Civil Engineers in London will hardly show 5% of such graduates we should imagine, though that statement is purely guesswork, based on general impressions of the British status. The contrast is doubtless due to the comparative youth of the city engineers for the most part, but it also indicates that the cities do not fill this position recklessly nor purely, according to comparative "inflooance."

Finally, the question arises as to how representative these 89 cities are. We have tabulated them therefore according to size, with the following result:

Population.	No. cities.
6,000 to 8,000	10
8,000 to 10,000	13
10,000 to 15,000	18
15,000 to 20,000	10
20,000 to 30,000	18
30,000 to 50,000	11
50,000 to 100,000	6
Over 100,000	3
Total	89

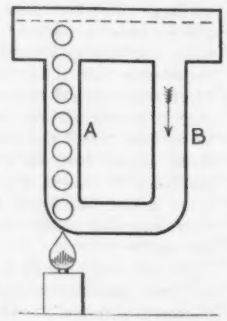
This shows a rather excessive representation of the larger cities, but as many of the smaller cities which chanced to have no water-works or sewerage system do not have any regular city engineer, the list must be considered fairly representative as to size as well as location of cities. If the city engineers will aid us in doing so, as we have requested above, we will extend these records, so that they shall be not only fairly representative, but substantially complete.

CIRCULATION IN STEAM BOILERS.

A curious fallacy respecting the circulation of water in steam boilers has received considerable publicity during the past year, and seems to demand a word of notice. In February, 1890, the late Geo. H. Babcock delivered a lecture before the students of Cornell University, in which he stated that the maximum rate of circulation occurred in a water tube boiler when the density of the mingled water and steam in the ascending column was one-half of that of the water in the descending column, and explained the reasons for this law. About a year ago Mr. J. J. Hogan contributed a long article to "Power," in which he set forth the highly novel theory that the bubbles of steam mingled with the water in the ascending column not only do not assist circulation, but actually impede it. So strongly was Mr. Hogan impressed with the correctness of his theory that he established a "Quarterly Boiler Review" to advocate it, designed a boiler in accordance with his ideas, and formed a company for its manufacture and sale.

How many converts he made to his theory on this side of the water, we are not aware; but we are suddenly apprised that he has made one convert in an unexpected quarter by the appearance of an article defending this theory in our usually reliable contemporary, the London "Engineer." In its issue of Jan. 12 that journal begins the publication of a series of articles on "Water Tube Boilers." The first number of the series is devoted chiefly to an attempt to prove the proposition that bubbles of steam rising through water in a pipe or passage do not tend to cause an upward movement of the water. To make the theory promulgated by our contemporary still more clear, we quote from it as follows:

> It is erroneously held by many persons that circulation takes place after ebullition has commenced, under such conditions as those indicated in the figure, because the leg A contains steam and water, while the leg B contains water only. There is no foundation in fact for this theory. It it were true, it would suffice to displace half the water in the ascending leg with corks to get circulation with cold water. The pressure of water is a function of the head and not of the mass; and so long as the head of water is the same in B as it is in A, it matters nothing what may be suspended in A, there will be no circulation. .... In the figure are seen a number of steam bubbles, which, of course, displace a certain volume of water. If now it were possible to weigh the contents of A and B, it would be found that the former was much the lighter. This being so, it is held that water flows from B to A. It seems sufficient to state the case to show its absurdity. We have already pointed out that corks might take the place of the bubbles in cold water, but no one dreams of saying that circulation would take place.



Our contemporary evidently considers that the argument concluding the above quotation is "a corker"; but, unfortunately for it, the continuous stream of corks, which it suggests might take the place of the steam, would as a matter of fact cause a similar upward movement, only less than that produced by the steam on account of the greater weight of the corks. The statement above that the pressure of the water is a function of the head, and not of the mass, is a correct enough proposition when static pressures are concerned. If we conceive each of the bubbles, or, if our contemporary prefers, globes of cork, in A in the figure to be anchored to the sides of the pipe, there will be no tendency to raise the column of water. But if the corks or bubbles are free to rise, then an upward pressure is exerted upon the water.

The principle involved in the circulation of a steaming boiler is in fact the same as that involved in the air lift pump, an American invention which was illustrated and explained at length in our issue of June 8, 1893. This device is already in extensive and successful use, but its great advantages and high efficiency seem to promise still wider and greater usefulness, as its advantages become better known.

In this device water is raised by forcing bubbles of air into the bottom of a partially submerged pipe. It is finding especial favor as a deep well pump, being particularly well suited to such use. We trust our contemporary will examine this apparatus and, if it still doubts, will satisfy itself by experiments, and then acknowledge its error, as it is a pity to have such a reputable technical journal attempting to controvert well established facts.

LETTERS TO THE EDITOR.

NATURAL FILTRATION OF WATER.

Sir: As your criticism of my paper on "Natural Filtration for Domestic Water Supply," in your issue of Jan. 4, 1894, would probably tend to misrepresent my position in some respects, would you kindly allow me to state:

(1) The paper under discussion was read solely for the purpose of presenting information regarding the method of natural filtration so that proper comparison could be made with other methods of obtaining pure water, before any definite plan should be adopted. I clearly state in my paper that I claim no superiority for the method, and, in fact, do not now think that it is the proper one to adopt.

(2) The plan submitted was for a supply for the city of Allegheny, where 30,000,000 gallons are required. The total amount now used by Pittsburg and Allegheny is about 80,000,000 gallons daily. Were infiltration galleries adopted for this total supply sufficient area at the rate of 300 gallons per sq. ft. per day would have to be provided. Such area could readily be obtained by the utilization of the "riffles" or shallows which occur in the Allegheny River every few miles.

(3) When the galleries are placed in a riffle but 10 ft. below the bed, nothing but clarified river water can be obtained. The reduction of bacteria will be but slight, as shown by the experience at Etna, which is mentioned in the discussion. Before water can be "filtered" (purified by means of nitrification.—Ed.) air must be supplied to the filtering medium. This method should therefore not be used in a stream which is too rich in organic matter. The Allegheny River, within 10 miles of the cities, is probably of this character. Galleries, such as described, should therefore not be used except as economical substitutes for settling basins prior to the running water through efficient filters.

(4) Were the galleries placed 20 to 25 ft. below the bed of the Allegheny River, the underground flow would be tapped. This water is undoubtedly free from bacteria. It is far safer to deal with such water than with surface water abounding with dangerous germs. Owing to a doubt as to the actual quantity that can be thus obtained and the impracticability of getting municipalities to make proper tests, the wisest and safest plan would be to adopt the best artificial filter known at present. Such is the sand filter.

(5) It is financially impossible to filter through sand the enormous quantities of water used in Pittsburg and Allegheny. The amount of the bonds required to cover the cost of constructing filter beds for the whole supply, together with the existing debt, would exceed the amount permitted by the city charters; besides the taxation for operating such a plant would be too burdensome.

The opinion of the people at large relative to the use of meters has never been determined. A large number are opposed to their use, especially the manufacturers, who are undoubtedly the cause of the abnormal demand for water. One very strong reason in favor of the non-use of meters at manufacturing establishments is that water should be supplied such concerns practically free as an inducement to locate in the city. As this is a question not within the power of engineers to settle the present condition of affairs must be taken in determining a proper solution of the problem.

(6) In view of these conditions, Mr. Geo. S. Davison, M. Am. Soc. C. E., and myself, at the same time advocated before the water committee of the local engineers' society, of which we are both members, the use of a dual supply, one of unfiltered water to the manufacturers and one of filtered water through the present distributing mains to the general consumers. The local conditions are such that a large percentage of the great consumers of water are situated along the rivers, so that new mains, supplied from low service reservoirs, can supply their requirements at a minimum cost.

The new works should be designed to supply at least 100 gallons per inhabitant. From estimates made such a system would increase the taxation but little, and either Pittsburg or Allegheny can readily raise the funds to construct one.

The report of the committee above mentioned will be made in a few days to the Associated Committees on Water Supply from the Chamber of Commerce, Medical Association, Chemists and Engineers' Society.

Yours very truly, Gustave Kaufman.

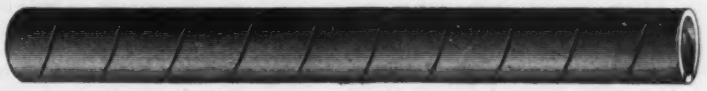
(Since Mr. Kaufman wrote the above letter the combined committee of which he speaks has reported, as noted on the first page of our last issue, in favor of filter galleries for clarifying the water required in Pittsburg and filter beds for purifying it, and a gradual adoption of the full meter system. It also speaks favorably of furnishing a separate and unfiltered supply to manufacturers in certain districts. The language of Mr. Kaufman's paper, from which we quoted on Jan. 4, would lead one to suppose that he was discussing filter galleries for both Allegheny and Pittsburg.—Ed.)

AN INNOVATION IN ROLLER BEARINGS.

For many years inventors have labored to produce a successful roller bearing, and the Patent Office records bear witness to their industry and ingenuity. The theoretical advantages of roller bearings have long been recognized; but, unfortunately, such bearings have not generally borne out the expectations of their inventors. This combined with the great cost of such bearings as usually constructed has thus far prevented them from coming into any extensive use. In fact so many different sorts of roller bearings have been experimented with, only to result in commercial failure, that engineers have generally settled down to the belief that roller bearings are impracticable.

The roller bearing which we illustrate herewith, however, deserves attention because it embodies an entirely new principle in such constructions and is claimed to overcome the chief difficulties which have thus far prevented success in this line. The inventor of this bearing is Mr. J. W. Hyatt, of Newark, N. J., well known to readers of this journal as the inventor of the Hyatt filter. The Hyatt Roller Bearing Co., with offices at 77 Liberty St., New York city, has been organized to manufacture and sell the new bearings. The success of Mr. Hyatt's roller bearing arises, first, from the use of flexible and elastic rollers and, second, from the adoption of a very ingenious and novel method of making such rollers.

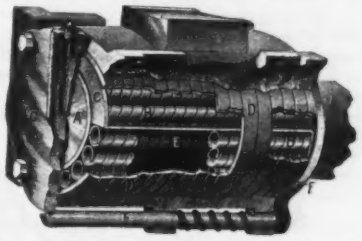
The general theory of a roller bearing that rolling friction is substituted for rubbing friction is familiar; but this theory assumes that the axis of the journal and the axes of the rollers are straight lines, all parallel to each other, and that the axis of the box which surrounds the rollers coincides with the axis of the journal. Now as a matter of fact the journal bends slightly under its load and thereby brings an unequal pressure on different parts of the bearing. Inequalities in the manufacture and adjustment of the box in which the journal turns also cause its axis to depart from the axis of the journal. With solid rollers the effect of this unequal pressure on different parts of the journal may at times become so great as to either slightly flatten the roller or injure the surface of journal or box; and when either of these things occurs the early destruction of the bearing is inevitable.



THE HYATT FLEXIBLE ELASTIC ROLLER.

What Mr. Hyatt has done is to substitute for the ordinary solid rollers a hollow flexible and elastic roller, one of which is shown in the accompanying cut. This roller is made from a single ribbon of steel wound on a mandrel to form a close spiral. This roller will not flatten and will not crush into the surface of the journal or box, but has elasticity enough to distribute the load of the journal, notwithstanding its bending and distortion. This roller may be likened in its action to a row of spring rings, each of which can bend slightly in carrying its load without interfering with the rings adjacent to it; but the spiral possesses, of course, the great advantage of being made in one piece. A point of practical merit which well supplements the action in service is that rollers can be made in this manner more cheaply than rollers made by turning and finishing in the ordinary manner. The ordinary solid rollers must be made of a grade of steel which can be hardened and tempered or the rollers will flatten. The Hyatt roller, on the other hand, is coiled from a ribbon of untempered open-hearth steel and requires no turning, tempering or grinding.

Of nearly equal importance with this improvement in roller construction is the adaptation of the same principle to the provision of true surfaces between which the rollers travel. The cut herewith shows a Hyatt roller bearing fitted to the axle of an electric motor car. It will be seen that a spiral steel ribbon is wound on the journal and another is slipped inside the box. Thus the bearing can be applied to a journal somewhat worn or a box slightly out of true without the necessity of turning or reboring. These spiral linings are used on motor cars and where heavy loads must be carried, but on ordinary shafting bearings the rollers are allowed to run directly on the journal and against the cast iron box. The principal applications of the bearing thus far have been on electric cars, but it has also been used on trolley wheels, transfer tables and ordinary shaft bearings.



Axle-Box of Electric Car Fitted with Hyatt Roller Bearings.

The many theoretical advantages which a roller bearing offers, compared with the ordinary rubbing bearing, have often been brought to the attention of engineers. The development of a type of roller bearing which promises to make these advantages practically attainable at a reasonable cost is certinly a matter of importance and deserves the attention of all those intrusted with the design and management of machinery.

THE EFFECT OF DIRT IN AIR-BRAKE PIPES.

At the January meeting of the Western Railway Club, Mr. Godfrey W. Rhodes, Superintendent of Motive Power of the Chicago, Burlington & Quincy R. R., read a paper on "Air-Brakes and Their Maintenance," which was in effect a continuation of the report presented by him last summer at the M. C. B. convention respecting the clogging of the screens in triple valves and in train-pipe drain cups by the dirt, scale, etc., which collect in the pipes (Eng. News, June 29, 1893). Before the Western Railway Club Mr. Rhodes showed 36 thimble screens from triple valves, which were wholly or partially filled with rust, cinder, scale and oil. One had a piece of iron $2 \times 1\frac{1}{2} \times \frac{1}{8}$ in.; another had a part of a hose gasket in it; another had a sliver of wood. In two cases the screen was filled full and the dirt extended back from it, filling a portion of the pipe. In another case a quantity of corn was found in the branch pipe just outside the screen.

To test the amount of scale on the interior of piping an 8-ft. section of pipe was removed from a refrigerator car and about 6 cu. ins. of scale was carried off its interior. In places this pipe was rusted nearly through. The presence of scale in new pipe was shown by jarring out about 5 cu. ins. from a 16-ft. 1¼-in. pipe after it had been bent and hammered and was ready to apply to the car. In applying piping to a car each length should have the scale jarred out before being put in place and the pipes should be blown out with air pressure before connecting the triple valve.

A very good suggestion is that the branch pipe from the main trainpipe should be connected at the top of the drain cup instead of at the bottom. Another means of preventing dirt from clogging the screens is to attach a small closed pocket to the screen into which the dirt can drop. This last named device has been tested on a three-car local passenger train run on a branch of the C., B. & Q. over a gravel-ballasted roadbed. The results showed that the pocket on the last car collected three times as much dirt as either of the other two, and that the dirt collected was chiefly fine sand and dust, while on the other two cars the dirt collected was chiefly pipe scale. The hose on the rear end of this car was at all times kept hung in the dummy coupling. It is argued from this that the dummy coupling is an inefficient means of protecting the hose against the entry of dirt, and that it would be even better to let the hose hang down than to place it in the dummy coupling.

It is a well known fact that the air-brake mechanism, notwithstanding its complexity, is exceedingly reliable under all sorts of abuse. Tests were made to determine how much the clogging of the triple valve screen would lengthen the time of charging the auxiliary reservoir from zero to 70 lbs. pressure. The tests were made with a trainpipe pressure of 95 lbs. The screen was filled as full as possible with a well-pounded mixture of sand, fine coal and iron rust. The results, showing surprisingly little interference with the action of the brake, were as follows:

Condition of triple screen.	Time in seconds charging reservoir to 70 lbs.
Filled with dry sand, pounded iron rust and coal	77
Ditto, except that the mixture was soaked in water	98
Ditto, except that the mixture was soaked in black oil	112
A new and clean screen was used in this test	68

As the feed port in the triple is barely 1-16 in. in diameter, this merely shows that the obstruction of the screen still left an opening nearly as large as the feed port. If, however, such a screen were to be let alone until the dirt became gummed up, a different result might be obtained. In proof of this, three New York triple valves with their screens plugged full of dirt were tested just in the condition which they were when removed from the car. The three showed respectively: 4 min. 25 sec., 3 min. 55 sec., and 3 min. 22 sec. as the time required to charge the reservoir through them to 70 lbs. Notwithstanding the fact that the screens were so badly clogged, these valves worked all right in the service application and release. The emergency, however, could not be obtained through them.

As showing how complete the stoppage was in these triple screens, tests were made with disks of wood ¼ in. thick, cut across the grain and placed in the trainpipe connection to the triple valve. The reservoir was charged to 70 lbs. through pine in 2 min. 40 sec. in one case, and the brake applied and released in the service movement through both pine and red oak. A white oak disk, however, prevented its action.

It is to be noted that dirty and gummed-up triples may do other harm than merely making the brake sluggish. One gummed-up triple valve piston on a C., B. & Q. coal car recently stuck when moved down and did not release. As the train was a long one the failure to release was not noticed and the car came into a station with a 4½-in. flat spot on every wheel. The rubber seat of the emergency valve is another place in the triple where defects are likely to occur. Oil from the cylinders reaches these seats and they grow soft and pulpy. From some recent experiments it appears that this rubber seat is likely to need replacing after some five to ten months of service.

In view of these facts it became a question whether appropriations for air-brake equipment

might not be profitably expended in the better maintenance of those already in service. It was even claimed that as much as 20% of the air-brake equipment passing over the C., B. & Q. was either inoperative or was not being used. Tests of this question were made, one at a point in Illinois and the other at a point in Iowa. They showed 18% and 12% respectively as the proportion of air-brakes inoperative. Following this, correspondence was instituted with the Atchison and the Union, Northern and Southern Pacific companies to learn whether similar difficulties had been experienced on those roads. All these companies replied that under the systems which they had in use little trouble was experienced from inoperative air-brakes and very few cars were allowed to run with the brakes cut out. The Atchison road formerly had much trouble with defective brakes, but has eliminated it by the establishment of air testing and repair plants throughout the system. To avoid delays, a supply of triples in good order is carried at air inspection points, and these can be quickly exchanged for those out of order with little delay to trains.

In conclusion Mr. Rhodes advocated the placing of a card on every car with its brakes cut out, stating the place where the brake was cut out and the cause. This would enable the brake to be attended to at once on arrival at its destination, and would save from puzzling over the cut-out car every conductor and car inspector from the beginning of the journey to the end.

RAILWAY OPERATIONS IN 1893.

The commendable feature of making a preliminary report on railway traffic and earnings some months before the final complete report appears, which was inaugurated last year by the Statistician of the Interstate Commerce Commission, has been continued this year with a report upon the income account of the railways of the United States for the year ending June 30, 1893. While figures seven months old cannot be said to be very recent, yet they are early in comparison with the final report, which, if we may judge from the date of former reports and the fact that the report for the year ending June 30, 1892, has not yet appeared, will not be issued before the middle of the year 1894. Moreover, these figures are the earliest and most complete which will be available for some months. We abstract some of the most important parts of this last report as follows:

The number of roads covered by this preliminary report is 479, representing 145,869 miles of line. Table I. shows the earnings and operating expenses for 1893, compared with those items for the four preceding years:

TABLE I.—Earnings and Operating Expenses per Mile of Road for the Years Ending June 30, 1893, 1892, 1891, 1890 and 1889.

	Per mile of line.					Inc. 1893 over
Item.	1893.[1]	1892.[2]	1891.[3]	1890.[4]	1889 [5]	1892.
Pass. service	$2,213	$2,104	$1,962	$1,978	$1,956	+ 109
Frt. service	5,068	4,946	4,689	4,589	4,204	+ 122
Other earn. from oper.	162	162	150	155	157	...
Unclassified	(6)	1	....	3	3	— 1
Total gross earn...	$7,443	$7,213	$6,801	$6,725	$6,320	+ 230
Operating expenses..	5,042	4,809	4,538	4,425	4,203	+ 233
Income from oper.	$2,401	$2,404	$2,263	$2,300	$2,087	— 3

[1] 145,869.58 miles. [2] 162,397.30 miles. [3] 161,275.17 miles. [4] 156,401.06 miles. [5] 153,385.87 miles. [6] Less than $1.

It will be noted that the gross earnings per mile of line increased from $7,213 in 1892 to $7,443 in 1893; the increase in operating expenses, however, more than counterbalanced this increase in gross earnings, resulting in a decrease in net earnings of $3 per mile, as compared with 1892. It should be borne in mind, however, that the returns for 1893 do not cover as large a mileage as those of 1892, and it is probable that the complete figures for 1893 will not make quite as favorable a showing, inasmuch as the inclusion of data for small lines that had not filed their reports in season for use in this compilation may tend to slightly decrease these averages.

Considered by groups the railways of the New England states show a decided increase in earning capacity both in the passenger and in the freight service for the year 1893 over that of the year 1892, the total gross earnings per mile of line being $13,133 in the former year and $11,152 in the latter. The figures also show a decided increase in operating expenses, these expenses being $9,157 per mile of line in 1893, former year and $11,152 in the latter. True figures it appears that the railways in the New England states show an increase in net income of $584 per mile of line.

The railways included in the territory lying east of Chicago and north of the Ohio and Potomac rivers (exclusive of the New England states) may also be easily separated for the purpose of compilation. A comparison of the gross earnings of 1893 with those of 1892 shows a slight increase. Thus, the gross earnings per mile of line for 1893 were $12,349 and for 1892 they were $11,933. Inasmuch, however, as there was nearly a corresponding increase in operating expenses per mile of line this increase in earnings gives to these railways only a slight increase in net income per mile of line. It is probable that full returns for the railways in the trunk line territory will reduce somewhat the per mileage earnings as above stated, since all the trunk lines are included in the compiled returns, while quite a number of the second-class lines are excluded because their reports were not filed in season to be used in this tabulation. The railways lying in the territory south of the Ohio and Potomac and east of the Mississippi rivers, which form naturally a group by themselves, show a total gross income per mile of line of $4,873 for 1893, as against $4,682 for 1892. In this case the movement in operating expenses is such as to give a small increase in net earnings.

The great difficulty in making a territorial classification in railway returns is found in the case of the

Subdivisions of the United States Adopted by the Interstate Commerce Commission.

Western roads, and consequently, for the purpose of obtaining the averages, all the railways lying west of a line drawn from Chicago to New Orleans via St. Louis have been considered as a single group. The gross earnings per mile of line for this territory also show an increase, being $5,599 for 1893, as against $5,445 for 1892. This increase in gross earnings is, however, more than offset by an increase in operating expenses, and therefore a slight decrease in net earnings from operation results.

The amount of service rendered by the railways during the year, as compared with previous years, is shown in Table II.

TABLE II.—Comparative Summary of Passenger and Freight Service for the Years Ending June 30, 1893, 1892, 1891, 1890 and 1889:

Year.	Pass. carried one mile per mile of line.	Tons carried one mile per mile of line.
1893	87,928	582,692
1892	82,285	543,365
1891	79,642	502,705
1890	75,751	487,245
1889	75,325	448,019

The significant figures in the above summary as indicating the development of railway service are those which show the density of passenger and of freight traffic. It will be observed that the increase in passengers carried one mile per mile of line and in tons of freight carried one mile per mile of line for 1893 does not differ in any marked degree from the ordinary increase of previous years, thus showing a constant, and, to a certain extent, a uniform expansion of business from year to year.

In Table III., which follows, will be found a comparison of net earnings and of dividends for the years ending June 30, 1893, and 1892, accruing on those roads whose operations are included in this preliminary report. The table presents totals by territorial groups, but too much reliance should not be placed upon this group classification, since it was necessary to assign the data for some roads lying in more than one group to a single group for the purpose of this compilation.

It will be observed by referring to the above summary that net earnings for the year 1893 are $350,257,749, being $9,774,957 in excess of net earnings for 1892. This amount is, roughly speaking, 3.50% on the capital of the roads reporting. In whatever way the matter be considered, the figures do not justify the assertion that the 12 months ending June 30, 1893, brought disaster to the railway industry. In this connection it should also be observed that the dividends declared during this period were $66,652,400, being $1,963,713 in excess of dividends declared during the previous year.

Another fact of interest is suggested by the above summary. By reference to the column headed "Surplus from Operations," it will be observed that the railways of the United States, in addition to the amount of dividends paid, were enabled to pass a surplus of $16,048,405 from their income account to their balance sheet. This, it is true, is not a large surplus to be declared on a basis of gross earnings of $1,085,685,281, but it shows that the railways, as a rule, maintained profitable activity. Four of the groups into which the territory of the United States is divided, that is to say, groups IV., V., IX. and X., show a deficit from operation; but the deficits in question arise on account of a high ratio of fixed charges rather than on account of a diverse ratio of net earnings to gross earnings from operation, and this fact is brought into notice as suggesting an interesting line of inquiry.

TABLE III.—Comparative Summary of Net Earnings, Surplus and Dividends for the Years Ending June 30, 1893 and 1892.

	Net earnings.		Dividends.		Surplus from oper.,
	1893.	1892.	1893	1892.	1893.
Group.	1 = 1,000.	1 = 1,000.	1 = 1,000.	1 = 1,000.	1 = 1,000.
I	23,573	21,042	9,262	8,010	945
II	88,788	86,157	20,432	21,158	8,232
III	48,315	48,563	9,660	9,409	359
IV	9,830	9,097	1,334	2,046	379
V	20,568	17,407	3,289	4,093	1,423
VI	75,697	75,869	15,870	13,614	4,206
VII	22,058	22,185	3,820	3,678	1,885
VIII	33,114	32,259	2,474	2,096	5,423
IX	8,730	7,385	5	6	787
X	19,779	20,511	509	573	2,014
T't'l, U. S.	350,252	340,483	66,652	64,686	16,048

RACK TESTS OF AIR-BRAKES BY THE M. C. B. COMMITTEE.

The committee of the Master Car Builders' Association on Tests of Air-Brakes conducted a series of tests on air-brake triple valves from different makers during the week ending Nov. 18, 1893. The triples tested were made by the Westinghouse, New York, Boyden, Crane and Lansberg companies and showed on the whole a very creditable efficiency in the apparatus of all the companies taking part in the tests except that of the Lansberg Co. The recent decision of the U. S. Circuit Court, however (Eng. News, Nov. 23), sustaining the broad patents on the quick-action triple valve held by the Westinghouse Air-Brake Co., makes the results of these trials a matter of comparatively little moment from one point of view, though they are still of much interest as showing the standard of efficiency which has been reached in air-brake manufacture. We do not reprint, therefore, the complete tables and chronograph records giving the result of the tests in detail. Those desiring such data for extended study of the subject should address Mr. Jno. W. Cloud, Secretary of the M. C. B. Association, Rookery Building, Chicago.

The tests were conducted on the special testing rack of the M. C. B. Association at Altoona, Pa. For those of our readers unfamiliar with rack tests we may explain that the testing rack consists of the complete brake equipment for a 50-car freight train, the push rods from the brake cylinder striking against a block of wood as they are forced out instead of moving the foundation rigging as when attached to a car. The test rack is so fitted that the regular triple valves can be removed and other triple valves substituted, so the test is a test of that wonderfully ingenious mechanism which constitutes the brain of the modern air-brake, the quick-action triple valve. An electric chronograph is connected to the test rack and automatically records with the minutest accuracy the movement of the several parts of the brake apparatus.

There were seven different sets of triples tested; two sets of the Westinghouse, one the standard set belonging to the rack, the other a set from the Wilmerding shops. Two sets from the Boyden Co. were tested, one set being of somewhat different construction from the other, and the Lansberg set of 50 triples was tested twice, the second test being made after some defects of construction had been corrected. The last set of tests only was reported.

The following is a brief summary of the results obtained in the several tests:

Test I.—This was to determine the length of time taken for the emergency application to run through a 50-car train, and the standard proposed

by the committee was that the maximum allowable time from the movement of the engineer's valve to the attainment of 55 lbs. pressure in the 50th cylinder should be 3½ seconds. This test was repeated nine or ten times on each set of triples and was made with the brake pistons set to 4 ins., 6 ins. and 12 ins. travel. The results of this test showed on all brakes a marked increase in the time of application with the longer travel of the brake piston. Part of this increase is due to the longer time required for the reduction in air pressure to run through the train; but it is chiefly due to the fact that the pressure runs up more slowly in the cylinder as the piston travel increases.

With 4 ins. piston travel the total time from the movement of the engineer's brake handle to 55 lbs. pressure, in the 50th cylinder, was 2.96 seconds for the Westinghouse triples belonging on the rack, 2.93 seconds for new Westinghouse triples from the Wilmerding shops, and for the other triples as follows: New York, 2.97; Crane, 3.58; Boyden (No. 1), 3.26; Boyden (No. 2), 3.31; Lansberg, 3.24.

With 6 ins. travel the averages were: Westinghouse (M. C. B.), 3.08 seconds; Westinghouse (Wilmerding), 3.02; New York, 3.24; Crane, 4.02; Boyden (No. 1), 3.38; Boyden (No. 2), 3.47; Lansberg, 3.42.

With the pistons traveling 12 ins. the New York and Crane were the only brakes which reached 55 lbs. in the 50th cylinder in every case. The average total times were, for each brake: Westinghouse (M. C. B.), 3.72; Westinghouse (Wilmerding), 55 lbs. not reached; New York, 4.42; Crane, 5.64; Boyden (No. 1), 55 lbs. not reached; Boyden (No. 2), 4.38; Lansberg, 4.32.

Test II.—This was a test of the ability of the emergency to jump one, two or three cut-out cars. The Westinghouse triples belonging to the rack could not get the emergency with brakes 1, 2 and 3 or 2, 3 and 4 cut out, but jumped 3, 4 and 5, 4, 5 and 6, etc., successfully. The Westinghouse triples from the Wilmerding shops and the Crane triples jumped every combination successfully. The New York triples failed with 1, 2 and 3 cut out and also with 3, 4 and 5 cut out after jumping 2, 3 and 4 successfully. The Boyden (No. 1) jumped two cars, but could not jump three. Boyden No. 2 jumped 3, 4 and 5 and 4, 5 and 6, but failed on 5, 6 and 7. The Lansberg jumped one cut-out car, but could not do more.

Test III.—This was a graduation test. With all pistons set to 6 ins. travel successive reductions in trainpipe pressure were made of 8, 14 and 30 lbs. All the brakes worked well in this test except the Lansberg, on which the 25th triple refused to operate until the maximum reduction was made.

Test IV.—This was a test of the sensitiveness of the emergency valve. Two triples from each set were taken at random and properly connected, with the engine and tender brake cut in. Then the trainpipe pressure being at 70 lbs. the air was allowed to escape through a disk opening in the engineer's valve, and if the emergency action was not secured a disk with an opening 1-64 in. larger was substituted. The results of this test were as follows. The Westinghouse M. C. B. triples gave full emergency with a 13-64-in. opening, and one of the Wilmerding Westinghouse triples did the same. The other required a 14-64-in. opening for full emergency. Both New York triples gave full emergency with 14-64-in. opening. Both Boyden valves showed about the same sensitiveness and the Crane valves were slightly more sensitive, one of them giving the emergency on a 10-64-in. opening. The Lansberg triples would not give full emergency even with 20-64-in. opening, the largest disk available.

Test IVa.—This was to determine the sensitiveness of the service action of the valve in a manner similar to that adopted for Test IV. One valve from each set was tested with the engine and tender brakes cut out. All the valves refused to move when air escaped through a 1-64-in. opening and all except the Crane and M. C. B. Westinghouse were moved by a 2-64-in. opening. These two valves moved with a 3-64-in. opening.

Test V.—This was to determine the holding-on power of the brake with both the service and the emergency application; records of the pressures in the 1st, 25th and 50th cylinders were taken immediately after application and at the ends of 5, 10 and 15 minutes. The test is really a test of the tightness of the triple, which may either allow air to leak from the reservoir into the cylinder and so raise the pressure, or it may allow air to leak out from the cylinder into the exhaust passage. No marked features of merit or demerit were developed in any of the brakes by this test. Valves of every make leaked more or less, as was to be expected in a test of such duration.

Test VI.—This was a release test made as follows: With a uniform pressure in the trainpipe of 70 lbs., all the air is exhausted from the trainpipe by the emergency application. A pressure of 90 lbs. is then maintained against a diaphragm with a 3-32-in. hole, through which air passes to the trainpipe. All brakes were set to 6 ins. piston travel. We summarize the results in the following table:

	No. of brakes released in each 5-minute interval:				
Brake.	0 to 5 min.	5 to 10 min.	10 to 15 min.	15 to 20 min.	Total in 20 min.
Westinghouse (M. C. B.)	3	18	18	1	40
" (Wilmerding)	0	14	33	0	47
New York	0	7	41	0	48
Crane	12	26	16	2	50
Boyden (1)	1	9	19	9	38
" (2)	1	9	17	2	29
Lansberg	0	16	2		18

Test VII.—This was to determine the time required to charge one auxiliary reservoir, the process being as follows:

(a). Cut out the brake to be tested by the cut-out cock. (b). Bleed the auxiliary reservoir, empty and close the bleed cock. (c). Secure 90 lbs. pressure on main air reservoir and trainpipe. (d). Shut off the pump. (e). Cut in the brake to be tested and note from the reading of the gage time occupied in charging 70 lbs. The time should not exceed 60 seconds nor be less than 45 seconds. The times of charging were as follows:

Brake.	Time of charging, seconds.
Westinghouse (M. C. B.)	72
" (Wilmerding)	68
New York	68
Crane	54
Boyden (No. 1)	56
" (No. 2)	45½
Lansberg	65

Test VIII.—This test was an additional one, not laid down in the original code of tests proposed by the M. C. B. committee, and it was to determine the much-disputed question as to the ability of the various brakes to obtain an emergency application after a service application has been made. The Westinghouse M. C. B. triples gave an emergency after 23.6 lbs. pressure had been secured in the first cylinder by a service application. They failed to give it on top of 29.1 lbs. in the first cylinder. The Westinghouse Wilmerding triples gave an emergency on top of 27.3 lbs. and failed to give it on top of 35 lbs. The New York triples gave the emergency on top of 48.2 lbs. in the first cylinder and did not fail to give it at any lower pressure. The Crane triples were unable to carry the emergency as far as the 25th cylinder, even with so low an initial pressure from a service application as 5 lbs. in the first cylinder. The Boyden (No. 1) ran the emergency to a point between the 25th and 50th cars with 20.9 lbs. in the first brake cylinder, and with 13.1 lbs. in the first cylinder ran it through the train. Boyden (No. 2) ran the emergency to a point between the 25th and 50th cars with 20.4 lbs. initial pressure, and it went through the train with 14.2 lbs. initial. The Lansberg could not get the emergency at all after the service was applied.

LONG STEEL TAPES.

Among the papers read before Division A of the International Engineering Congress (in charge of the American Society of Civil Engineers), was one by Mr. R. S. Woodward, on "Recent Experience on the U. S. Coast and Geodetic Survey in the Use of Long Steel Tapes for Measuring Base Lines." We must refer our readers to the paper itself for the full detail of this experience, but make some extracts, as follows:

The investigation into the practicability of using long metallic tapes for measuring lines of precision was taken up by the Coast and Geodetic Survey in the autumn of 1890, under the direction of the writer, who devised the apparatus here described. Steel tapes 100 m. long were used in 1891 to measure the Halton base, in Indiana. The five sections of this base of 5,500 m. were measured from 6 to 30 times each, under various conditions of temperature, time of day, etc. In October, 1892, another base of 3,900 m. was measured in the same chain of triangulation, at St. Albans, W. Va.

These "100-meter" tapes were made of steel. Each tape was 101.01 m. long, and 6.34 mm. by 0.47 mm. in cross-section, or 0.39 in. by 0.018 in. The tape weighs 22.3 gr. per meter of length; or, about 104.5 grs. per lin. ft. It is subdivided into 20 m. lengths by graduations ruled on the surface of the tape itself, and as the tape is 101.01 m. long the end graduations fell about 0.5 m. from the tape ends. These ends terminated in loops formed by annealing and riveting the tape back on itself. The surface of the tape was a dull black color, except where polished to receive the graduations. A reel was used for transportation.

A tape-stretcher was used, made as follows: To a small wooden platform, on which the operator stands, a piece of steel tubing terminating in a hickory handle was hinged by a universal joint. Along the upper two-thirds of the tube a screw-thread was cut, upon which a wheel nut played freely. To the upper part of this nut was fixed a gimbal-jointed support, having attached in front an ordinary spring balance, reading to ounces, and at the back a rod upon which slipped a small counterbalance weight. The tape was attached to the spring balance by a short piece of sash chain and the balance could easily be held to the nearest ounce by the operator. An important item for the safety of the tape was a "breaking link" at each end of the tape which would part at a tension of about 30 lbs. The chief objection to this tape-stretcher was its weight of 45 lbs.; though an able-bodied operator can handle it successfully in measuring at the rate of 1¼ miles per hour.

Centigrade thermometers were used, graduated on the stem to half degrees, and made by Green, of New York. Though originally mounted on brass scales, these scales were removed and light wire loops attached to the upper ends of the stems; the purpose of this change being to isolate the thermometer from adjacent masses, or to whirl it in the air when necessary. When two thermometers were used they were placed generally at one-fourth the tape's length from the ends respectively. When three were used one was put at the middle and one at one-sixth the tape-length from the ends. For the most precise work, as in comparing for tape lengths, the three thermometers were read twice, once just before and once after the observations on the tape. The mean of these six readings thus gave the tape's temperature with a probable error of $\pm 2°$ C., equivalent to $1 = 500{,}000$ part of the tape-length, when observations were made at night or under the comparator shed.

When measuring a line the tape was supported at equal intervals of 10 to 20 m. throughout its whole length. The most convenient and ample sufficient support was provided by steel wire nails driven into stakes set at the proper intervals and ranged in line by small theodolite. The ends of the tape were supported by the tape-stretchers. The marking stakes were scantling cut off and driven down to the proper height and capped by a small table on which was a plate of zinc held by light nails, the plates being 5×20 cm. with the longer sides parallel to the line. On the plates the position of the forward end graduation was marked by a sharp brad awl held against the edge of a small try-square, which is aimed against the longer edge of the marking plate. The rear end graduation is in turn brought into coincidence with the successive marks on the zinc plates.

The marking and support stakes are ranged and adjusted beforehand, especially for work of the highest precision carried on at night. For rapid measurement 12 men are required; two observers of the tape, one at front and one at rear; two observers of the thermometer, who also help to carry the tape forward; one recorder; two men at the stretchers, and five men to handle lamps and carry the tape forward. All signals are made by whistles according to an understood code. The speed attained is usually 2 km., or 1¼ miles, per hour.

The writer then proceeds to describe in detail the measurement of the St. Albans base, with tables of observations and results. It is sufficient here to say that the probable error in the whole

base of 3,900 m. on three given suppositions varied from 1-1620000 to 1-2720000 part of the base. The writer says it is safe to conclude that the probable error of the adopted length of the St. Albans base, from all sources, save that of error in the tape-length, could not exceed 1-2000000 part. The extreme probable error in the tape-length is put down at ± 0.06 mm.; and combining this with the error from all other sources, as given above, the total probable error in the St. Albans base is put down at ± 3.02 mm., or 1-1280000 part.

Mr. Woodward concludes his paper with a mathematical appendix giving necessary formulas.

The abolition of highway grade crossings in New York is to be brought before the legislature by the railroad commission, and it is expected that a bill will be introduced based on the present Massachusetts law. Steps are to be at once taken to ascertain the total number of highway grade crossings in the state.

The advantages of freight traffic on electric railways have been pointed out in our columns, and the new Mousam River R. R. has been built to operate passenger and freight traffic by electricity between Sanford, Me., and Springvale, on the Portland & Rochester R. R. The road is three miles long, laid with 60-lb. T-rails on cedar ties, with gravel ballast. For passenger service there are two closed passenger motor cars, two open trail cars and two baggage and express trail cars. Each motor car has two 20-HP. Westinghouse motors. Freight cars are hauled by a ten-ton motor car or electric locomotive, 27 ft. long, having four 36-in. wheels and two 30-HP. Westinghouse motors. This engine runs nearly 30 miles per day, hauling coal cars and general freight. The power plant has a 70-HP. Corliss steam engine and a 150-HP. water-wheel. The locomotive can haul four loaded freight cars up a grade of 5¼%. The motor cars and locomotive cab are lighted and heated by electricity.

The two new lighthouses being built by the Philadelphia Iron Works for the use of the U. S. government at Cape Charles and Hog Island, Va., are to be provided with elevators, worked by hand, a novel feature in lighthouse construction. The total height of each lighthouse is 192 ft. 8 ins., with the focal plane 175 ft. above the base. The structure has a diameter of 53 ft. tapering to 11 ft. at the floor of the service room, 149½ ft. above the base. It is built in seven stories of cast iron columns and struts arranged on an octagon, braced and tied diagonally by rods. In the center is a cast iron column 9 ft. in diameter, lined with ⅛-in. sheet steel, to give a smooth finish, and provided with a cast iron spiral stairway. The elevator works inside of the stairway. The foundation is made of eight circular disks embedded in concrete and tied to the base of the central cylinder.

The permissible load per square foot on highway bridges, according to the Swiss ordinance of Aug. 18, 1892, is 92¼ lbs. on both pavement and roadway for bridges on main highways, and 71.7 lbs. per sq. ft. on secondary roads in the same district, or for important roads outside of much traveled centers. On certain public roads outside of this category 51¼ lbs. is permitted; but it is specified that in the three cases mentioned the wheel load calculated for is 5, 3 and 1½ French tons respectively.

A self-propelling 8½-ton steam fire engine, the largest and most powerful yet made anywhere, is owned by the city of Hartford. This engine is of the Amoskeag type, is about 10½ ft. high and 17 ft. long and can throw 1,350 gallons of water in one minute. The driving is done through two endless chains running over sprocket wheels on each of the rear wheels; the arrangement permits running backward or forward, and the machine can be stopped within 50 ft. At a late trial the engine threw a horizontal stream of water, through 50 ft. of 3½-in. hose, a distance of 348 ft., and threw two streams, each as large as that from an ordinary steam fire engine, a distance of 300 ft. The common steam fire engine weighs about 6,000 lbs. and throws from 500 to 600 gallons of water per minute.

Brick street pavement is discussed at length in the last annual report of City Engineer F. W. Cappelen, of Minneapolis, Minn. He says that at present Minneapolis has a total of 800 miles of streets and 300 miles of graded streets. Cedar block paving on plank figures at 71⅔ miles; asphalt, 2½ miles, and there are 9½ miles of granite pavement on sand. The present price of cedar block pavement is 85 cts. per yard; but Mr. Cappelen recommends the laying of all future pavement of this kind on a concrete base with tarred joints, which would raise the price to about $1.50 per yard. He believes the experience in Minneapolis with granite blocks on the sandy soil of that city does not warrant the expense of a concrete base. Experiment has shown that good clay for paving brick can be found near Minneapolis, and brick made from it, on the Hallwood standard form, would cost, laid in the pavement, from $1.80 to $1.90 per sq. yd. Mr. Cappelen presents the following table showing the relative cost of different pavements for a period of 20 years on a street with a business traffic:

Kind of paving.	Cost, sq. yd	Cost of removal.	Years worn.	Cost per year.
Cedar, with planks, no tar.	$ .85	$ .79	6	$ .29
Cedar, concrete and tar	1 45	.74	8	.30
Granite	1.88	1 88	20	.25
*Asphalt	2.75	....	..	...
Small Minnesota brick	1.80	1 13	10	.33
Large Minnesota brick	1.90	1.23	10	.33
Galesburg brick	2.15	1.48	10	.40½
Ohio brick	2.70	2.03	10	.52

* Kept in repair for 10 years, after which add 8 cts. per yd. per year.

A monolithic red granite column, 41½ ft. long, 6½ ft. in largest diameter and weighing 92 tons, has been successfully transported from Stony Creek, Conn., to West Point, N. Y. It is intended for the Battle Monument in the latter place. The shaft was loaded on two platform cars on two heavy pedestal blocks, and crossed the river at Fishkill after the transfer bridge had been strengthened. The original block from which the shaft was cut weighed 135 tons. It will be surmounted by a granite ball 4 ft. in diameter supporting a bronze figure of Victory.

The Stark system of rapid transit, tested and favorably reported upon in 1886 by the Massachusetts Railroad Commissioners, is strongly urged by Gen. Herman Haupt for adoption in New York. The system proposed by Gen. George Stark requires an elevated track, with central rail operated upon by two horizontal drivers pressed against this central rail by controllable hydraulic power. The cars proposed would seat 104, as against 48 in the present elevated car, and General Haupt figures that 8-car trains carrying 49,320 persons per hour will, owing to the lightness of engine and train resulting from their peculiar form and operation, impose no more strain upon the existing elevated structure than the ordinary 5-car train with a capacity of 9,000 per hour. He compares the cost of the systems available, per mile, as follows: Stark system, double-track, on posts 33 ft. apart, with rolling stock, $317,364; New York elevated system, with rolling stock, $534,317; London underground, $2,339,000 to $5,000,000; Berlin viaduct, four tracks, $2,045,454. He would substitute island platforms for the present side platforms, to accommodate the longer trains. General Haupt also favors the use of compressed air motors, as compared with steam or electricity.

A process of plating aluminum has been devised by Professor Neesen, a German chemist, which shows very good results. The aluminum is first dipped in a solution of caustic potash or soda, or in muriatic acid, until bubbles of gas begin to appear, then into corrosive sublimate, then a second time into the caustic or acid, and finally in a solution of a salt of the desired metal. A film of the metal is rapidly formed, and adheres so firmly that, in the case of gold, silver or copper, the plate may be rolled out or polished.

The English eight-wheel express engine "James Toleman," which was designed by Westwood & Winby, of London, and exhibited by them at the World's Columbian Exposition, is being given service trials on the Chicago, Milwaukee & St. Paul Ry. The engine was described in our issues of April 13 and Sept. 28, 1893, and its special features are the use of an oval boiler and four high-pressure cylinders. It has never been in service on any English road. According to report the boiler capacity is found to be too small to supply live steam to four cylinders, a feature which we criticised in the article of our issue of Sept. 28, 1893. The Chicago, Milwaukee & St. Paul Ry. is also making trials of the double-end express locomotive "Columbia," which was exhibited by the Baldwin Locomotive Works, and has been purchased by the railway company. An engine of this type was described and illustrated in our issue of June 15, 1893.

The first practical test of the great turbines of the Niagara Falls Paper Co. took place on Jan. 25. This is the first application of power from the works of the Cataract Construction Co., which cost $4,000,000, and have a capacity of 120,000 HP. The three turbines tested on Jan. 25 are of 1,100 HP. each. They were designed by Mr. Emil Geyelin, and were built by R. D. Wood & Co., of Philadelphia. The wheel-pit leading to them is 13 ft. in diameter and 155 ft. deep. The contract of the paper company calls for 6,000 HP., one-half of which is now being used, at $8 per horse power per year for 24 hours per day. The Cataract Construction Co. expects to open its general power-house and operate its 5,000-HP. turbines for the generation of electricity about June 1.

The city of Baltimore, Md., is asking the legislature for authority to create a $5,000,000 loan for the following purposes: For increasing the number of public parks, $1,000,000; enlarging the water supply, $2,000,000; for the new court house, $1,000,000; for paying the floating debt and discharging the maturing debt of the city, $1,000,000. The money set aside for the water supply would be expended largely in increasing the size of mains and in extending the supply in the new wards of the city.

The Belleville water-tube boilers for the new fast lake steamers mentioned in our issue of Jan. 11 are being built by the Globe Iron Works Co., of Cleveland, O., which is also building the steamers. The equipment consists of 28 boilers for each steamer and is the only large equipment ever built in this country. These boilers are not in use in any other lake steamers, and the exclusive use of water-tube boilers in large steamers is, so far as this country is concerned, an innovation. Three American yachts, the "Shearwater," "Wild Duck" and "Sultana" and the yacht

WEATHER TABLE FOR DECEMBER, 1893. [Furnished to Engineering News by the Department of Agriculture.]

	Stations.	Temperature. (Deg. Fahr.) Average	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average	Max.	Direction at time of max. velocity.	Precipitation — rain or melted snow—inches. Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	16.4	54	—27	81	9.0	36	SW	2.92	0.90	16
	Portland, Me.	22.0	46	— 9	55	7.6	30	W	5.42	1.45	19
	New York, N. Y.	35.1	63	13	50	11.6	42	NW	3.49	1.00	15
	Pittsburg, Pa.	35.6	64	15	49	8.0	26	SW	2.70	0.95	18
	Chicago, Ill.	25.4	58	— 6	64	22.0	54	SW	2.14	0.81	14
	Omaha, Neb.	26.8	60	— 5	65	8.0	24	W	1.13	0.19	8
	St. Paul, Minn.	12.4	40	—16	56	7.7	42	NW	2.35	1.27	12
	Duluth, Minn.	11.2	43	—19	62	6.8	36	NW	1.91	0.58	12
	Bismarck, N. Dak.	8.6	44	—29	73	9.6	56	NW	1.49	0.52	13
	Average	21.5	52	— 9	62	10.0	38		2.62	0.89	14
Southern Cities.	Washington, D. C.	38.3	65	11	54	6.8	36	NW	2.27	0.75	10
	Louisville, Ky.	38.6	68	13	55	9.9	37	W	2.44	1.28	9
	St. Louis, Mo.	36.3	66	8	58	14.0	42	W	1.32	0.58	7
	Savannah, Ga.	54.5	76	31	45	8.2	30	S	3.12	1.17	6
	Kansas City, Mo.	35.4	66	2	64	11.0	38	SW	0.43	0.33	6
	Jacksonville, Fla.	58.8	77	35	42	7.2	23	W	3.08	2.19	6
	Chattanooga, Tenn.	44.5	67	22	45	7.0	34	S	3.46	1.26	10
	New Orleans, La.	58.4	79	33	46	9.2	48	N	2.31	1.08	4
	Memphis, Tenn.	45.8	73	18	55	8.1	36	NW	2.61	1.67	7
	Palestine, Tex.	54.4	80	26	54	7.0	26	W	1.77	1.27	4
	Average	46.5	72	20	52	8.8	36		2.28	1.16	7
Western Cities.	Helena, Mont.	31.2	51	— 1	52	8.5	42	SW	0.58	0.46	6
	Port Angeles, Wash.	41.5	61	28	33	4.7	34	W	4.45	1.11	18
	San Francisco, Cal.	52.4	72	37	35	6.0	25	S	2.25	0.97	8
	Salt Lake City, Utah	36.3	57	18	39	4 4	42	NW	2.37	0.87	12
	Santa Fé, N. Mex.	33.7	53	5	48	7.0	38	NW	0.49	0.22	5
	Denver, Colo.	38.2	65	8	57	8.7	48	NW	0.35	0.12	7
	Yuma, Ariz.	57.8	83	34	49	6.6	32	N	0.26	0.14	3
	Average	41.6	63	18	45	6.6	37		1.54	0.56	8

tender "Coryell," are equipped with this type of boiler. The numerous applications of these boilers in vessels of the French naval and merchant marine, the Russian naval service, etc., proves them beyond the experimental stage, and the builders expect good results from those they are making.

The Universal Cartographic Machine Co., of 23 Budge Row, Cannon St., London, has been organized to put upon the market a machine for lettering maps, charts, etc., and for numbering consecutively up to 10,000. From a very meager description furnished this journal the machine appears to be arranged on the principle of the typewriter, and by a simple adjustment it will print the title in straight lines, in semi-circles or on reversed curves. It is claimed to work ten times as fast as handwork of an equally good type, and to be precise, neat, certain and uniform. It is apparently an Italian invention, and the government of that country is said to be using 56 of the machines. The price of a single machine is high, but the promoters believe that it will pay for itself in a short time when compared with the cost of the high-priced hand labor usually employed for this purpose.

The officers of the Delaware, Lackawanna & Western R. R. have been investigating the block systems in use on different roads running into New York, the directors of the company having decided to adopt a block system of operating trains.

The block system is now in operation on the New York Central R. R. all the way from New York to Niagara Falls, 462 miles. The lock-and-block system is used, with electric locks for all switches.

The Chicago Shipbuilding Co. is about to construct a timber dry dock at Chicago with the following dimensions: Length, 425 ft., with provision for extension to 475 ft.; width at top, 100 ft., at bottom, 80 ft.; gate, 70 ft. wide with 17 ft. of water over the sill. The longest boat at present on the lakes is 380 ft. in length.

The projected Canada-Australia cable, says Mr. Sandford Fleming, would be 6,244 miles long and cost $7,000,000, if it did not touch the Fiji Islands or New Zealand. Mr. Fleming assumes that the cable would be laid by and would belong to the colonies benefited and not be operated as an ordinary commercial enterprise. Allowing for an ample margin for all contingencies, he puts the total cost at $8,725,000, and believes that this sum could be borrowed by the colonies at 3½, making an annual interest charge of $261,750. Counting depreciation at $160,000 and the operating expenses at $300,000 per year, the total annual amount to be met would be $721,750. He bases his estimate of revenue on the business of the Eastern Extension Co., which last year transmitted 1,275,190 words, at $1 per word. The promoters of the new cable believe that they could secure half of this business, and at 50 cts. per word this would amount to $318,797, or half the annual charge figured. But Mr. Fleming believes the cable would be self-supporting within seven years after completion, and would later yield a handsome profit, due to low rates and the natural expansion of the traffic between Canada and Australia.

CONSTRUCTION NEWS.

(Readers are invited to contribute items concerning new construction of interest to engineers or contractors for insertion in these columns. Those using these pages for information are informed that announcements of calls for proposals are inserted but once, and are not repeated from week to week.)

RAILWAYS.

East of Chicago—Existing Roads.

CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS.—Press reports state that this company proposes to construct a belt line from Alexandria, Ind., by way of Frankton to Elwood.

LONG ISLAND.—The extension of this road on Long Island from Port Jefferson to Wading River, 12 miles, has been commenced and is to be completed by June 1, according to reports.

OTTAWA, ARNPRIOR & PARRY SOUND.—It is reported that the contract for the third ten-mile section west of Eganville, Ont., has been awarded to J. O'Brien, Renfrew, Ont.

TEMISCOUATA.—A charter has been obtained for a 29-mile extension to connect with the Bangor & Aroostook at Van Buren, Me., according to reports, and the line will be built this summer. Pres., J. J. McDonald, Riviere du Loup, Que.

Projects and Surveys.

CHICAGO, UNION CITY & CINCINNATI.—It is started the Foster, Bailey & Keeferl, Huntington, Ind., have been awarded a contract for building ten miles of this proposed road, noted Jan. 4.

Southern—Existing Roads.

BRISTOL, ELIZABETHTOWN & NORTH CAROLINA.—Benj. S. Dulaney, Receiver, Bristol, Tenn., has been authorized to spend $6,000 for ballasting and repairing the roadbed of this short road.

TAMPA & THONOTOSASSA.—Reports state that this railway, noted Jan. 18, will be extended at once to Owensboro, Fla., a distance of 20 miles. Pres., S. A. Jones, Tampa, Fla.

TENNESSEE CENTRAL.—We are indebted to J. S. McNair, Chicago, for the following: A line is projected between Nashville and Knoxville, Tenn., 132 miles. A lease has been secured from the existing Nashville & Knoxville of 80 miles of completed road from Lebanon to Standing Stone. By the proposed scheme a new line will have to be built between Lebanon and Nashville, 32 miles, and from Lebanon east to Knoxville, 100 miles. Four miles of grading has been done east of Standing Stone. Estimated cost, $10,000 per mile. Further information can be obtained by addressing Mr. McNair, as above, or ex-Gov. Jere Baxter, Nashville, Tenn.

Projects and Surveys.

FREDERICK & MIDDLETOWN.—Incorporated in Maryland to construct a steam or electric railway; capital stock, $100,000; P. H. Bussard, C. H. Coblentz, P. W. Stafer, Middletown, Md., and Geo. Wm. Smith, Frederick, Md., are among the incorporators.

ROANOKE MINERAL BELT.—Application has been made for a charter for this company, which proposes to construct a railway from Roanoke, Va., to a connection with the Richmond & Danville system between Rocky Mount and Franklin Junction, a distance of about 30 miles.

Southwest—Existing Roads.

MYRTLE SPRINGS SHORT LINE.—It is reported that the grading has been commenced of this proposed railway from Myrtle Springs, Tex., to Will's Point, a distance of about eight miles. Ch. Engr., T. J. McKain, Will's Point, Tex.

TEXAS MIDLAND.—The contract for building the extension to Ennis, Tex., has been awarded to the Bethume-Craney Construction Co., Kansas City, Mo., the work to be completed within 60 days.

Projects and Surveys.

HOUSTON BELT & SUBURBAN.—Incorporated in Texas to construct a railway 21 miles in length; capital stock, $125,000; directors include O. H. Brown, H. D. Brown, W. C. Duvall, R. K. Cage and J. H. Berry, Houston, Tex.

SAN ANTONIO & GULF SHORE.—Press reports that the contracts for building the first 75 miles of this proposed railway from San Antonio, Tex., to Velasco, has been awarded to J. F. Flieke, Dixon, Ia.

WILLIAMSVILLE, GREENVILLE & ST. LOUIS.—Incorporated in Missouri to build a railway from Williamsville, in Wayne county, to the Mississippi River, in Ste. Genevieve county, a distance of 100 miles; $1,000,000; H. N. Holliday, C. W. White, C. A. Haynes, Williamsville, Mo.; Eli Klatz, Piedmont, Mo.; F. A. Wann, E. S. Orr, St. Louis.

Rocky Mt. and Pacific—Existing Roads.

BURLINGTON & MISSOURI RIVER.—Press reports state that this company has commenced proceedings for condemning land for the right of way and terminals in the city of Billings, Mont., acting under the charter of the Big Horn Southern Ry. Co., which it has purchased.

MONTANA SOUTHERN.—About 20 miles of grading has been completed on this railway south from Whitehall, Mont., and the tracklaying will be commenced early in the spring. The road will extend to Dillon, a distance of about 105 miles from Whitehall. Ch. Engr., S. N. Kielland, Whitehall, Mont.

Projects and Surveys.

COLORADO.—It is reported that a corps of engineers has been at work for several weeks surveying a route for a railway from Colorado Springs, Colo., to Cripple Creek, by way of Bear Creek, a total distance of 25 miles.

GILA VALLEY, GLOBE & NORTHERN.—The directors of this company are reported to have arranged with Wm. Garland, Los Angeles, Cal., to commence the construction of this proposed railway from Bowie, Ariz., on the Southern Pacific, to Globe, 130 miles, about Feb. 1. Pres., E. A. Cutter, Bonita, Ariz.; Vice-Pres., D. W. Wickersham, Bowie, Ariz.; Treas., A. C. Laird, Los Angeles, Cal.

Foreign.

PHILIPPINE ISLANDS.—The concession for a railway from Manilla to Taal, passing through Calamba and Batangas (Philippine Islands), a distance of about 78 miles, will be sold at public auction at Madrid, Spain, March 16. The contract is said to be valued at $3,710,730. For particulars address the Consul-General of Spain at London, England.

STREET AND ELECTRIC RAILWAYS.

HINESBURGH, VT.—H. M. Hull writes us that Frank O. Singclair, Burlington, is making surveys for a projected electric railway to Burlington, 12 miles, but that no company has yet been organized to build the road.

BOSTON, MASS.—It is stated that the Boston, Revere Beach & Lynn R. R. expects to commence equipping its line to use the trolley system in the spring.

BROCKTON, MASS.—Reports state that the Brockton St. Ry. Co. will begin as soon as the frost is out of the ground, to construct three roads—one to Bridgewater by way of West Bridgewater, another to Elmwood, through East Bridgewater, and another to Stoughton.

ROME, N. Y.—The stockholders of the Rome City St. Ry. Co. are considering the advisability of using electricity as the motive power for the road, the change to be made in the spring. Extensions are also proposed.

BARNEGAT, N. J.—The Barnegat R. R. Co., has been incorporated to construct a railway in Barnegat City and Long Beach; capital stock, $50,000; Pres., Wm. J. Sewell, Camden, N. J.

BURLINGTON, N. J.—The Burlington County Electric Co. has been organized with a capital stock of $125,000 to construct an electric railway between this city and Mt. Holly, to carry both passengers and freight, according to reports.

PITTSBURG, PA.—The Braddock & Homestead St. Ry. Co. has been incorporated to build a street railway 1¼ miles long; capital stock, $7,500; Pres., C. Jutte.

BALTIMORE, MD.—It is reported that the Baltimore & Washington Boulevard Co. is receiving bids for the construction of a part of the proposed electric railway to Washington. Ch. Engr., F. R. Hambleton.

—A bill has been introduced in the legislature granting a charter to the Baltimore & Anne Arundel Electric Ry. Co. to build a railway about 10 miles in length, capital stock, $50,000.

DAYTON, O.—H. S. Fox, Co. Surv., is surveying a route for a projected eletric railway from Harshman through this city to Miamisburg, and it is reported that the construction of the road will be commenced in the spring.

ALTON, ILL.—The Alton Electric St. Ry. Co. is trying to float $250,000 of bonds to change the motive power of its road to electricity, according to reports.

CHICAGO, ILL.—The South Side Extension R. R. Co. has been incorporated by Marcellus Hopkins, W. R. Champlain, E. L. Lobdell, W. W. Gurley, Chicago, and D. R. Lewis, Evanston; capital stock, $1,000,000.

FREEPORT, ILL.—It is reported that C. E. Loss & Co., Chicago, will commence this month the construction of a $100,000 electric street railway system in this city to supplant the present horse-car line.

OAK PARK, ILL.—The town board has granted a franchise to the Cicero & Proviso Electric Ry. Co., and the council of Chicago will now be petitioned for authority to lay tracks on Chicago Ave. and Lake St. to connect with the present Lake St. line.

CHEYENNE, WYO.—The Cheyenne St. Ry. Co. has sold the rails now in use and will rebuild its road, changing it to a standard gage and adopting electricity as the motive power, according to reports.

ST. LOUIS, MO.—The Citizens' Ry. Co. is preparing to rebuild its western extension on Easton Ave. to the city limits, about two miles, and will change the motive power from mules to electricity.

ENID, OKLA.—The Enid St. Ry. Co. has been incorporated.

SALT LAKE CITY, UTAH.—The East Tintic Ry. Co. has been incorporated to build 2½ miles of street railway near Mammoth, in the Tintic mining district; capital stock, $5,000; Wm. McIntyre, trustee, 499 of the 500 shares; L. C. Trent, S. H. Hill, W. H. Bradley and others.

PORTLAND, ORE.—The Portland & Gresham R. R. Co. has been incorporated with a capital stock of $50,000.

ELEVATED RAILWAYS.

CHICAGO, ILL.—A local paper states that the executive committee of the Metropolitan Elevated R. R. Co. has decided to adopt electricity as the motive power on that road. No definite contract has yet been made for the electrical equipment, but the management has for some time been carefully studying the matter and has now decided that electricity is the best motive power they can use. Several electrical companies have offered to put in an electric plant for operating the road and guarantee the expense of operation to be below that of any other method. The committee, however, is inclined to put in the electric plant on the company's responsibility and is now studying the various methods for applying such motive power.

HIGHWAYS.

MASSACHUSETTS.—It is estimated that the proposed boulevard between New Bedford and Fall River will cost about $200,000.

NEW YORK.—Mamaroneck, Westchester Co., has appropriated $4,000 for grading and macadamizing the Mamaroneck Boulevard, the principal highway from that town to White Plains.

OHIO.—Bids are asked until Feb. 6 for macadamizing and grading the Belmont and Portland county free turnpike. T. W. Moore, Chn. Comrs., Steubenville.

NEBRASKA.—The commissioners of Douglas county, Omaha, have received bids for $150,000 of bonds for the purpose of paving and macadamizing three country roads.

MISSOURI.—Bids are asked until Feb. 16 for grading and macadamizing in Jackson Ave. F. J. O'Flaherty, Co. Surv., Independence.

TEXAS.—Bids are asked until Feb. 12 for the paving of two highways. John G. Todd, Co. Judge, Houston.

IDAHO.—Press reports state that Winter, Parsons & Boomer, Butte, Mont., have been awarded the contract for a state wagon road from Salmon City to Challis, and into the Bear Valley, a distance of about 100 miles through a mountainous country. The construction will be commenced about March 1.

BRIDGES AND TUNNELS.

ROCHESTER, N. Y.—The city surveyor has prepared plans for a stone arch 531 ft. long to abolish the New York Central grade crossing at University Ave. This arch provides for a street 60 ft. wide extending under it and is estimated to cost $250,000. An iron bridge over the tracks at this place is another plan under consideration.

BENNETT, PA.—Bids are asked until Feb. 6 for an iron bridge on Sheridan St. Samuel Eades, Burgess.

PITTSBURG, PA.—The contract for the Neville Island bridge has been awarded to the Wrought Iron Bridge Co., Canton, O. The bridge will be 1,028 ft. long, including approaches, have three central spans of 248 ft. each and will cost about $150,000, according to reports. It will be used by the Cornopolis & Neville Island electric railway as well as for general traffic. Plans have been prepared for a free bridge at 22d St. for the South Side. It is expected that the plans will be approved this week and the construction commenced as soon as the necessary authority has been secured from congress.

CHARLESTON, S. C.—The Charleston Bridge Co. will receive bids until Feb. 19 for the reconstruction of the Ashley River bridge, as stated in our advertising columns.

TAMPA, FLA.—The city has contracted with the Groton Bridge Co. for a $70,000 bridge across the Hillsboro River, subject to a vote of the citizens.

CLEVELAND, O.—The board of control has adopted plans for a short bridge over the C., C. & S. Ry. tracks at Petrie St. and a high embankment across the remainder of Morgan Run Valley, and has voted to

award contracts as follows: Superstructure, Variety Iron Wks. Co., $10,493; masonry substructure, Spellacy & Craig, $24,835; earth embankment, W. J. Garone, $29,859.

CHICAGO, ILL.—The lowest bid for the new Van Buren St. bridge was that of A. Gottlieb, at $59,700. There were 12 bids, the highest being $85,000.——A large number of bridges and viaducts in the city are reported as needing repairing.

MILWAUKEE, WIS.—The bids for the steel superstructure of the 16th St. viaduct, 4,000 ft. long, were published Dec. 7. The latest reports indicate that all will be rejected and the work readvertised.

PHILLIPSBURG, MONT.—The Butte "Miner" states that the contract for the 7,000-ft. tunnel beneath Granite Mountain, noted Jan. 11, has been awarded to Richard Moyle & Co. The work is claimed to be the most important of the kind ever undertaken in the state, and will require nearly two years to complete it.

SOREL, QUE.—The council has granted a bonus of $50,000 toward the building of an iron bridge and viaduct over the Richelieu River, according to reports.

STE. EDWIDGE, QUE.—It is stated that three bridges are to be erected here in the spring, two across the Saumon River and the other over the Moes River.

WATER-WORKS.

LAWRENCE, MASS.—The city treasurer will receive bids until Feb. 8 for $327,000 of water bonds.

MEDFORD, MASS.—The council has voted to petition for authority to purchase lands for increasing the supply.

READING, MASS.—The commissioners have secured plans for a filter plant estimated to cost $5,000, according to reports.

WEYMOUTH, MASS.—The town has authorized a water loan of $50,000.

MOUNT VERNON, N. Y.—Information in addition to that given last week states that the new stand-pipe will spend between $300,000 and $400,000 in improving the works. A new 4,000,000-gallon pump will probably be secured.

NEW YORK, N. Y.—The department of public works will receive bids until Feb. 6 for a supply of pipe, hydrants, etc., and for pipelaying in 17 streets.

ROCKVILLE CENTER, N. Y.—G. B. Latimer and W. C. Foster have petitioned for a franchise for a proposed water company.

TONAWANDA, N. Y.—The Niagara River Water-Works Co. has offered to sell its plant to the city for $275,000, payable in 30-year 4% bonds and an election will be held Feb. 13 to vote on the question.——Water extension bonds for $65,000 have been sold to Isaac W. Sherrill, Poughkeepsie, at 1.03⅛% premium.

TOTTENVILLE, N. Y.—The Tottenville Water Co. has been incorporated with a capital stock of $100,000.

BURLINGTON, N. J.—Geo. A. Allinson, Supt., informs us that the contract for two 100-HP. tubular boilers has been awarded to the Lebanon Boiler, Foundry & Machine Co.

NEWARK, N. J.—The bids for a 225,000,000-gallon reservoir, published last week, were so low that all have been rejected, and it is proposed to build a reservoir of nearly double that capacity.

OCEAN GROVE, N. J.—H. B. Ayers, Clk., writes us that it is proposed to sink more artesian wells to secure an increased supply, especially during July and August.

ORANGE, N. J.—The committee has recommended the erection of a 7,000,000-gallon pumping plant at Campbell's Pond, according to reports.

HARRISBURG, PA.—The commissioners have recommended the immediate purchase of a new pumping engine. A filter plant is also proposed.

LIGONIER, PA.—Press reports state that the city is negotiating with J. H. Harlow & Co., Pittsburg, and other engineers for plans for works.

SALISBURY, PA.—The local press is agitating the question of works.

WILKES BARRE, PA.—The Crystal Spring Water Co. has prepared plans for a 100,000,000-gallon reservoir on Pine Run.

BALTIMORE, MD.—The mayor has recommended a loan of $2,000,000 for extending and enlarging the supply.

WEST POINT, VA.—Morgan Treat, Chn. Com., writes us that an election will soon be held to vote on an issue of bonds, recently authorized, and that if the proposition is carried the town will purchase material and put in works, including a 40,000 to 50,000-gallon tank, supply to be from a river; population, 2,500.

CALHOUN, GA.—It is reported that works may soon be put in.

GRIFFIN, GA.—The Griffin Consolidated Light & Water Co. informs us that the city contemplates purchasing the plant and is now receiving bids for a stand-pipe. An electric plant will also be added. No engineer has been engaged.

PERRY, GA.—J. H. Powers writes us that the city hopes soon to construct a water-works and electric light plant, to be operated by water power, but that the necessary authority has not been secured.

ROME, GA.—The council is considering plans for extending the mains to East Rome.

BARTOW, FLA.—D. W. Stanley, Cy. Clk., writes us that bonds have been voted for works, the supply to be from wells, but that no plans have been adopted; population, 1,500.

BIRMINGHAM, ALA.—The Birmingham Water Co. has offered to sell its plant to the city and accept 30-year 6% bonds in payment.

COLUMBIA, ALA.—W. A. Brown, Mayor, writes us that the city proposes to put in works as soon as possible, the supply to be from an artesian well; will want 18 hydrants and about 10,000 ft. of 6 to 1-in. pipe; population, 1,200.

MARION, ALA.—The contract for works, including three miles of mains and a stand-pipe, has been awarded to C. E. Waller, Greensboro, at about $18,000.

UNION SPRINGS, ALA.—J. D. Norman, Mayor, writes us that an artesian well has been bored and that works may be put in this spring; population, 2,500.

FRANKLIN, KY.—S. N. Forline, Cy. Clk., writes us that the city has contracted with W. R. Bush, Lake City, Fla., to put in works, the construction of which will probably soon be commenced. The city is to pay $1,000 per year for 40 hydrants.

MOUNT STERLING, KY.—The Mount Sterling Water-Works Co. has been granted a franchise, and it is expected that the construction of the works will be commenced about Feb. 15. Chas. Peters, Engr., will receive bids for the work, which includes reservoir and stand-pipe; population, 5,000.

ATHENS, O.—C. R. Sheldon, Vil. Clk., writes us that the citizens have ratified a contract with Stevens & Bedwards, Logansport, Ind., the village to pay $4,000 per year for 61 fire hydrants and to have the privilege of purchasing the works within one year. The works will cost about $41,000, and the supply will be from wells; population, 3,000.

LOCKLAND, O.—The council has sold $20,000 of 5% 30-year water bonds for $20,524 and has awarded the contract for works to D. R. P. Dimmick, Newport, Ky., at $19,585. The works will include eight miles of mains and 40 hydrants and the construction will be commenced as soon as possible.

SANDUSKY, O.—C. A. Judson, Supt., writes us that the council has directed the city solicitor to prepare an ordinance submitting the question of issuing $30,000 of bonds for extensions to the voters at the April election.

FAIRMOUNT, IND.—It is reported that the town contemplates putting in works.

KNIGHTSTOWN, IND.—Bids will soon be asked for works, including stand-pipe. A. E. Carroll, Mem. Com.

LIGONIER, IND.—Works will soon be secured, according to reports.

ROCKPORT, IND.—The Rockport Water-Works Co. will probably lay about two miles of extensions in the spring.

SALEM, IND.—It is reported that an additional supply will be secured.

VEVAY, IND.—The mayor is reported as stating that he would like to learn the cost of works for this city.

GRAND RAPIDS, MICH.—The council has authorized the purchase of a new pump for the hill service.

ASTORIA, ILL.—It is reported probable that the city will soon have works and electric lights.

CENTRAL PARK, ILL.—The town of Cicero is negotiating for a supply from the Chicago mains.

EAST ST. LOUIS, ILL.—The City Water Co. has increased its capital stock from $750,000 to $1,500,000.

EDWARDSVILLE, ILL.—Wm. H. Hall, Mayor, writes us that the city expects a proposition soon for a franchise, which will probably be granted if reasonable.

GOLCONDA, ILL.—The question of works is reported as being discussed.

HILLSBORO, ILL.—About a mile of extensions will probably be laid in the spring.

JOLIET, ILL.—The council is considering the construction of a gang of tube-wells, according to reports.

KIRKWOOD, ILL.—The city is reported as negotiating with an engineer for plans for works.

LEMONT, ILL.—It is stated that a better supply is to be secured for fire protection.

MINONK, ILL.—About a mile of mains will probably be constructed next summer.

MONTICELLO, ILL.—The city is reported as planning extensive improvements, including about five miles of additional mains.

PETERSBURG, ILL.—It is reported that the works will be extended this year.

TREMONT, ILL.—We are informed that the Tremont Water-Works Co. has been incorporated to put in works; capital stock, $3,500; Pres., Daniel Johnson; Secy., J. Velde.

WHEATON, ILL.—The mayor is reported as stating that works will be constructed this spring.

WYOMING, ILL.—Works will soon be put in, according to reports.

BERLIN, WIS.—The following bids were received for providing works: D. A. McLeod, Manistee, Mich., 76 hydrants at $100 per year each; O. J. Gorman & Co., Dallas, Tex., 76 hydrants at $3,040 a year and $40 for each additional hydrant; F. B. Barns, Oshkosh, 90 hydrants at $3,600 per year and $30 for each additional hydrant; W. S. Reed & Co., Chicago, 75 hydrants at $55 each per year.

KENOSHA, WIS.—Reports state that W. S. Reed and E. Newcomer, Chicago, have prepared plans for a system to cost $150,000, the contractors to issue bonds to be guaranteed by the city and the plant to revert to the city at the end of 30 years.

REEDSBURG, WIS.—C. C. Stevens, Cy. Clk., writes us that bids will be received until Feb. 8 for works and an electric light plant; water supply from wells; population, 2,500.

BOONE, IA.—Bids are asked until Feb. 7 for extensions. Jesse L. Hull, Cy. Clk.

PRAIRIE CITY, IA.—It is reported that the council is considering the question of works.

CALEDONIA, MINN.—An election was held Jan. 20 to vote on the question of works; estimated cost, $8,000.

GLENCOE, MINN.—An election was held Jan. 30 to vote on incorporation and to authorize the council to lease water-works and electric lights.

HUTCHINSON, MINN.—The council is talking of putting in works, according to reports.

MORTON, MINN.—We are informed that the council is considering the question of works, but that no definite action has yet been taken.

CREIGHTON, NEB.—A. J. Marsh, Vil. Clk., writes us that an election has been called to vote on an issue of bonds for $9,000 to put in works, but that no other steps have been taken.

VALLEY CITY, N. DAK.—It is reported that the council is considering the question of works.

DILLON, MONT.—The contract for work has been awarded to Winters, Parsons & Boomer, Butte, at $46,500. The work will be done by Cooper & Chapman, Spokane, according to press reports. The contract was awarded to the San Francisco Bridge Co. last summer, but the company has refused to execute the contract, which is now awarded to the next lowest bidders.

DARDANELLE, ARK.—Thos. Cox, Mayor, writes us that the council is considering the granting of a franchise to Jos. Evins to extend the works, supply to be from mountain springs five miles distant.

PRESCOTT, ARK.—The council is reported as considering the construction of works.

SEARCY, ARK.—A 20-year franchise for works and an electric light plant has been granted to J. T. Pullen and W. G. Brown, Little Rock.

AUSTIN, TEX.—Press reports state that a contract for about $100,000 worth of cast iron pipe has been awarded to a Birmingham, Ala., pipe company.

BAIRD, TEX.—We are informed that contracts will probably be awarded this month for works, to cost about $10,000, including dam 26 ft. high and 650 ft. long, reservoir and 10,000 ft. 6-in. pipe. Engr., J. S. Thatcher, Dallas, Tex.

BRENHAM, TEX.—The city has issued $11,000 of water bonds, according to reports.

BROWNSVILLE, TEX.—The construction of works continues to be discussed, according to reports.

DALLAS, TEX.—It is reported that the recommendations of Chester B. Davis, Chicago, for increasing and improving the supply are substantially the same as those made by the city engineer last October and published in our issue of Nov. 2.

GAINESVILLE, TEX.—The council has authorized an issue of $10,000 of water bonds for boring an artesian well.

WEST, TEX.—W. H. Uscary writes us that the West Water, Light & Electric Co., noted last week as incorporated, will receive bids until Feb. 1 for boring well and laying pipes.

GUTHRIE, OKLA.—The city is reported as contemplating extensions of the system in the spring.

ASPEN, COLO.—The Castle Creek Water Co. was incorporated Jan. 22; capital stock, $150,000. This is probably the same company which built the works in 1886.

CANON CITY, COLO.—G. T. Conaway, Supt., writes us that a contract for pumps has been awarded to F. P. Lannon, Pueblo, provided bonds are sold; pumps, well, foundation and new water-wheels estimated to cost $15,000. Engr., W. F. Haws, Denver.

FLORENCE, COLO.—The United Oil Co. has commenced the extension of the works to a new addition to the city, according to reports.

HIGHLANDS, COLO.—The council is considering the granting of a new franchise, also the purchase of works.

SOUTH DENVER, COLO.—The council is considering an offer of the Citizens' Water Co., Denver, to furnish a supply for 10 years at 5½ cts. per 1,000 gallons.

TACOMA, WASH.—The superintendent has been directed to extend the system in ward 4 at an estimated cost of $12,000.——Geo. H. Sellers, Engr., has renewed his offer to secure a daily supply of 10,000,000 gallons from Thomas and Patterson springs for $450,000, according to reports.

HANFORD, CAL.—It is reported that larger mains will be put in this spring.

HAMILTON, ONT.—Wm. Haskins, Cy. Engr., has recommended that an additional set of pumps be erected at the beach, and that a new reservoir be built at a high level.

KINCARDINE, ONT.—The council is considering the purchase of the works.

TORONTO, ONT.—E. H. Keating, Cy. Engr., has recommended an appropriation of $17,941 for new mains, and has reported estimates for the new tunnel and duplicate main scheme, which would cost $710,000.

CHARLOTTETOWN, P. E. I.—The citizens will vote this month upon an expenditure of $20,000 for an additional main, authorized by the legislature last year.

ARTESIAN WELLS.

OCEAN GROVE, N. J.—H. B. Ayers, Clk., writes us that additional artesian wells are proposed.

GRAND VIEW, S. DAK.—Bids are asked until Feb. 15 for sinking and constructing four artesian wells in Douglas county. Bids were also asked until Feb. 8 for four artesian well warrants. M. N. Stults, Co. Aud.

GAINESVILLE, TEX.—It is reported that the council will soon sink an artesian well.

IRRIGATION.

NORTH LOUP, NEB.—The North Loup Irrigation Co. is reported as awarding contracts for 300,000 ft. of lumber to be used in flume and bridgework, and it is said that work on the ditch will be resumed as early as possible in the spring.

DENVER, COLO.—The bill appropriating $25,000 to aid in the construction of a reservoir at Twin Lakes has passed third reading in the house.

NEW COMPANIES.—Benton Drainage & Irrigation Co., Greeley, Colo.; $10,000; John G. Benton, B. S. La Grange, J. Gladstone.——Danskin Ditch Co., Blackfoot, Idaho; $30,000; Pres., A. Whitten; Secy., I. Erickson; Treas., Josiah Hobbs.——Hastings Irrigation Canal & Power Co., Hastings, Neb.; $500,000; Pres., W. H. Mayo, St. Louis; Vice-Pres., V. C. Shickley, Geneva, Neb.; Secy., I. Ledlo'yt, Hastings, Neb.——Island Irrigation Co., Enterprise, Ore.; $100; Wm. Mokin, Wm. McCormack, L. W. Riley.——Yulupa Land & Water Co., Sacramento, Cal.; $90,000; L. L. Lewis, A. C. Tufts, Evaline N. Tufts.

SEWERS.

BURLINGTON, VT.—Bids will soon be asked for an extension of the outlet sewer into Lake Champlain. H. M. McIntosh, Cy. Engr.

BRISTOL, CONN.—The "Herald" states that the city is to have a complete system.

BUFFALO, N. Y.—The following bids have been received: John Munn, $4,442 for a sewer in Wyoming Ave. and $3,490 for one in Cambridge St.; Otto Faber, $3,987, $3,437, respectively; H. Kibben, $6,300, ——; William Franklin, $4,800, $4,370; W. A. Rappich, $5,625, $4,803; Jacob Ritzman, $4,700, $3,917; Henry Harter, $4,423, $4,256; F. J. Martin, $4,572, $3,971; Patrick Battle, $5,279, $4,474; August Gise, $4,560, $4,850; Frank Kobb, $5,221, $5,300; Ed. Sell, ——, $4,645.

JAMESTOWN, N. Y.—Wm. B. Landreth, Engr., informs us that the following bids were received Jan. 24 for the North Side sewers: Norris & Wieskel, Findlay, O., $55,113; W. J. Irwin, Greenville, O., $57,775; A. C. Curtis & Co., Carlisle, Ark. $61,906; Sanders & Houston, Pittsburg, $59,992; John McGregor, Buffalo, $60,251; W. G. Smith, Buffalo, $59,198; Miller & Gick, Saratoga Springs, $64,388; Dunn Brothers, Scranton, Pa., $64,378; J. W. Kelly, New Brighton, Pa., $67,670; Ryan & McConnell, Buffalo, $58,468; A. W. Yawger, Bucyrus, O., $67,533; Ritzmann & Miller, Buffalo, $77,000; F. E. Gribben, Youngstown, O., $65,000; Evenson, Liddle & Co., Jamestown, $67,950; Maguire, McKnight & Co., Buffalo, $59,795; W. B. Connell, Youngstown, O., $62,943; Gebert & Prout, Fostoria, O., $52,624; W. H. Roberts, Chartiersboro, Pa., $60,007; Rider & Fitzgerald, Dunkirk, $73,519; Lo Valley & Jenkins, Elmira, irregular; Grimes & Morn, Elkhart, Ind., irregular.

LONG ISLAND CITY, N. Y.—The contract for a sewer in Broadway has been awarded to J. C. Sheehan, New York, at $359,408.

NEW ROCHELLE, N. Y.—Plans for sewage disposal works, noted last week, are being prepared by J. K. Wilkes, Ch. Engr. Comn., who informs us that it is intended to construct the works this coming season.

NEW YORK, N. Y.—The department of public works will receive bids until Feb. 7 for constructing sewers, 10 contracts, and for a supply of brick, cement, sand, sewer pipe, etc.

HOBOKEN, N. J.—It is reported that bonds for $100,000 will be issued for a lateral system in Union Hill, and that the contract will probably be awarded in three sections.

ALLEGHENY, PA.—Bids are asked until Feb. 1 for one main and three lateral sewers. Robt. McAfee, Dir. Pub. Wks.

MUNCY, PA.—A system is being talked of, according to reports.

PHILADELPHIA, PA.—Bids are asked until Feb. 5 for repairing the Cohocksink main sewers. J. H. Windrim, Dir. Pub. Wks.

BALTIMORE, MD.—An ordinance is being considered by the council appropriating $173,000 for a sewer to be constructed by day labor.

ALEXANDRIA, VA.—A petition is to be presented to the legislature for authority to issue $200,000 of 30-year 5% bonds for building sewers and extending streets.

HUNTINGTON, W. VA.—A sewer contract has been awarded to H. L. Wright, at about $40,000, according to reports.

MACON, GA.—Bids are asked until Feb. 26 for about 42 miles of sewers, as stated in our advertising columns.

HAMILTON, O.—The sewage commission has voted to engage Geo. W. Pierson, Kalamazoo, Mich., to prepare plans and estimates for a complete separate system. Dr. Beeler, Secy. Comn.

EVANSVILLE, IND.—Bids are asked by the board of public works until Feb. 10 for constructing two local sewers.

HUNTINGTON, IND.—W. S. Shields, Chicago, has been engaged as consulting engineer of the proposed system for which H. H. Wagoner, Cy. Engr., is preparing plans, as recently noted.

ALTON, ILL.—The council has passed an ordinance for constructing a 3-ft. double-ring brick sewer, average cut 10 ft.

AURORA, ILL.—Bids are asked until Feb. 17 for constructing 5,830 ft. two-ring brick, 160,390 ft. 24 to 9-in. and 79,530 ft. 6-in. pipe sewers; 210 manholes, 555 catch basins, etc. M. G. Stolp, Cy. Engr.

PEKIN, ILL.—We are informed that extensions and improvements are to be made to the system.

QUINCY, ILL.—Bids are asked until Feb. 3 for 4,000 ft. of 8 and 12-in. pipe sewers, average cut 10 ft. E. R. Chatten, Cy. Engr.

MADISON, WIS.—O. S. Norsmann, Cy. Clk., writes us that the city is considering plans from McClellan Dodge, Cy. Engr., and from other engineers for sewage disposal works, but that no definite action has yet been taken.

MARINETTE, WIS.—The awarding of a $50,000 contract to O. G. Kringle, Kenoska, was recently noted in these columns. E. L. Shaw, Cy. Engr., writes us that after completing about half of the work Mr. Kringle abandoned the same, and that his bondsmen, American Surety Co., New York, have contracted with W. M. Campbell, Marinette, to complete the work, for $30,300.

KEOKUK, IA.—It is reported that the council has voted to spend $150,000 for improving sewers and streets, but S. T. Bisbee, Cy. Clk., informs us that no sewer work has yet been ordered.

MUSCATINE, IA.—The sewerage committee has been authorized to employ an engineer to make surveys for a system.

SIOUX CITY, IA.—Bids were received as follows Jan. 23: E. J. Hanlon, $17,552, $17,370, $9,049, for sections 1, 2, 3, respectively; Lewis Wesley, $22,391, $21,569, $11,943; L. C. Johnson and R. F. Baker, $25,793, $22,064, $14,204; Nels Nystrom, $20,309, $17,311, $9,583; J. L. Black, $26,220, $25,536, $16,813; J. E. Riley, $22,940, $21,945, $14,295; J. B. Keefe, $17,695, $15,339, $9,148; Smith & Conlin, sec. 2, $18,850; sec. 3, $10,775; contracts awarded to Mr. Hanlon.

MINNEAPOLIS, MINN.—The city engineer has recommended the construction of several main sewers.

ROCHESTER, MINN.—The board of trade is considering the question of a system.

SIOUX FALLS, S. DAK.—S. B. Howe, Cy. Engr., informs us that the council is considering the construction of 4,183 ft. of 75 to 20-in. brick or stone sewers, average cut 12 ft., estimated cost $82,500, and 12,744 ft. of 24 to 8-in. pipe sewers, average cut 11 ft., estimated cost $15,500; the outlet to be into the Big Sioux River. The work will require about 6,000 cu. yds. of rock excavation.

ST. LOUIS, MO.—The sewer commission has recommended the building of an independent system at Benton.

TEMPLE, TEX.—A franchise has been granted to R. L. Hollingsworth & Co. for a sewer in several streets.

SEATTLE, WASH.—Plans have been prepared for two sewers; length, 3½ miles; estimated cost, $75,000.

LOS ANGELES, CAL.—The contract for the Hill St. sewer has been awarded to T. W. Young, at about $57,000. A contract has also been awarded to Ramish & Marsh, at $13,500, and additional work has been ordered.

SAN FRANCISCO, CAL.—Permission has been secured for the construction of a sewer across the Presidio reservation and the committee has recommended the immediate construction of an outlet sewer into the ocean for the Richmond system.

HAMILTON, ONT.—Wm. Haskins, Cy. Engr., has recommended the construction of a trunk sewer in three streets.

STREETS.

BOSTON, MASS.—The street commissioners have adopted plans for continuing Boylston St. 80 ft. wide from Back Bay Fens to Brookline Ave.; estimated cost, $250,000 to $300,000.

CAMBRIDGE, MASS.—The superintendent of streets has been authorized to contract for 17,000 ft. of edgestones, 300,000 granite paving blocks and 500,000 brick; also for a stone crushing plant to cost $5,000.

JAMESTOWN, N. Y.—The city has been authorized to issue $10,000 of bonds to be used at once for grading and improving streets.

NEW YORK, N. Y.—Bids are asked by the department of public works until Feb. 13 for grading, flagging, curbing, etc.; nine contracts.

BAYONNE, N. J.—Bids are asked until Feb. 6 for $50,000 of 5% 6-year improvement bonds. W. C. Hamilton, Cy. Clk.

ALLEGHENY, PA.—Bids are asked until Feb. 1 for grading, paving and curbing in five streets. Robt. McAfee, Dir. Pub. Wks.

MONONGAHELA, PA.—T. M. Boggs, Cy. Clk., writes us that the city will hold an election Feb. 19 to vote on an issue of $20,000 of bonds for brick paving and for 24-in. pipe sewers.

NEW CASTLE, PA.—J. H. Miller, Cy. Engr., informs us that the city will probably pave 60,000 sq. yds. with fire brick. The work includes 8,000 lin. ft. of sandstone curbing and is estimated to cost $25,000, but has not yet been advertised.

PHILADELPHIA, PA.—Thirteen bids were received for extending the west river drive in Fairmount Park, the lowest being John Lynch, $67,805; Robt. Patton, $68,283.

SHIPPENSBURG, PA.—The contract for grading Main St. has been awarded to Hafer Bros., Chambersburg, at about $7,000. The highest bid was $19,000.

WAYNESBORO, PA.—An election will be held Feb. 20 to vote on an issue of $15,000 of street improvement bonds.

BALTIMORE, MD.—The city will pave several streets with Belgian blocks to give work to the unemployed.

ALEXANDRIA, VA.—A petition is to be presented to the legislature for authority to issue $200,000 of 30-year 5% bonds for extending streets and sewers.

AKRON, O.—An ordinance has been passed to bond the city for $150,000 for street improvements.

ASHTABULA, O.—The street committee is considering the paving of about 7,600 sq. yds in Center and Prospect Sts.

CINCINNATI, O.—Bids are asked until Feb. 19 for constructing brick sidewalks.——The board of administration is considering the paving of several streets with brick.——Plans are being prepared for $100,000 worth of work in Bates Ave.

PLEASANT RIDGE, O.—Bids are asked until Feb. 19 for improving Mound Ave. J. M. Harper, Engr., Cincinnati.

SPRINGFIELD, O.—A bill has been introduced in the legislature authorizing the city to issue $10,000 of street improvement bonds.

KOKOMO, IND.—Bids are asked until Feb. 6 for stone, gravel, brick, tile, cement, etc., during 1894. D. A. Smith, Cy. Clk.

MUNCIE, IND.—It is reported that bids will soon be asked for paving the business streets with brick; some asphalt paving to be done later.

TERRE HAUTE, IND.—Bids are asked until Feb. 20 for paving several streets with brick. C. H. Goodwin, Cy. Clk.

CHICAGO, ILL.—The Chicago Cement Sidewalk Co. has been incorporated by J. C. Ficklin, M. B. Olmstead and F. C. Lowes; capital stock, $10,000.

QUINCY, ILL.—E. R. Chatten, Cy. Engr., informs us that plans are being prepared for about 48,000 sq. yds. of brick paving and 21,000 lin. ft. of sandstone curbing; estimated cost, about $77,000.

KEOKUK, IA.—The council is reported to have decided to spend $150,000 in street and sewer improvements, and it is expected that the paving of Main St. with brick will soon be commenced.

MUSCATINE, IA.—It is proposed to pave several streets with brick.

MINNEAPOLIS, MINN.—The city engineer in his annual report congratulates the city in having secured granite paving for $1.58 per sq. yd. and he recommends that in the future all cedar blocks be laid on a concrete foundation which is expected to increase the cost from 85 cts. to $1.45 per sq. yd., but would reduce the cost of repaving to 74 cts.

ST. PAUL, MINN.—Bids are asked until Feb. 5 for constructing cement and wooden sidewalks. J. T. Kerker, Clk. Bd. Pub. Wks.

HAMILTON, ONT.—The city engineer has recommended that several streets be paved with Trinidad asphalt.

TORONTO, ONT.—It is stated that the city has 30 or 40 miles of streets paved with cedar blocks that need repaving.

ELECTRIC LIGHT AND POWER.

EAST BRIDGEWATER, MASS.—Reports state that Howard T. Marshall is organizing a company to put in an electric light plant.

LOCKPORT, N. Y.—The council is considering the question of a municipal electric light plant. Cons. H. Cornes, Cy. Engr.

EASTON, PA.—Bids are asked until Feb. 13 for 80,000 carbons. L. M. Fine, Cy. Clk.

BENWOOD, W. VA.—A committee is soliciting subscriptions for $35,000 of stock for a proposed electric light company.

DAWSON, GA.—A. J. Baldwin is reported as interested in a company which proposes to put in an electric light plant to cost $10,000.

GRIFFIN, GA.—The city contemplates purchasing the water-works of the Griffin Consolidated Light & Water Co. and will add an electric light plant.

PERRY, GA.—The city contemplates putting in an electric light plant.

COLUMBIA, ALA.—W. A. Brown, Mayor, writes us that the city wants electric lights and water-works and would like to have interested parties visit the city.

NEW CONNERSTOWN, O.—A franchise has been granted to Geo. I. Fleming, the plant to be in operation by July 1.

NILES, O.—The Falcon Iron & Nail Co. is reported as expecting to put in an arc light plant.

INDIANAPOLIS, IND.—The county commissioners have rejected all bids for an electric light plant for the courthouse and jail and new bids will soon be asked for.

DETROIT, MICH.—The lowest bids for the construction of the municipal electric light station were as follows: Excavations, J. M. Spaulding, $3,934; piling, A. J. Dupois, $9,500; masonwork, W. H. Travers, $24,600; carpenter work, J. L. Gearing & Sons, $7,412; cut stonework, T. J. Heard, $3,295; painting and glazing, J. H. Wiltsie, $2,100; plumbing, John D. Mouat, $2,225; roofing and metalwork, Whitehead & Lewis, $4,872; ironwork, Brown-Ketchum Co., Indianapolis, $6,412.70; stack, Van Dorn Iron Works, Cleveland, $2,433; total, $66,725.

SPARTA, WIS.—The city is considering the advisability of buying an electric light plant.

MANKATO, MINN.—Bids are asked until March 1 for 50 to 100 2,000-c. p. arc, and 50 to 150 32-c. p. incandescent lights for 10 years. Henry W. Brown, Cy. Clk.

WYNNE, ARK.—It is reported that the Kennedys & Morelock Stave Co. are contemplating putting in an electric plant for public lighting.

DALLAS, TEX.—Bids are asked until March 1 for an electric light plant, including about 300 arc lamps and 80 miles of wire. Geo. N. Cruthers, Cy. Secy.

MONCTON, N. B.—Bids are asked until Feb. 12 for a complete municipal electric light plant. Thos. Robb, Cy. Clk.

MEXICO.—Bids are asked in our advertising columns for a 500-HP. electric power plant, the power to be transmitted 12 miles. Logan, Clark & Demond, 58 William St., New York.

NEW COMPANIES.—American Subway Co., Camden, N. J.; $100,000; Henry Hess, C. C. Adams, A. S. Carpenter, Philadelphia, and others.——New Sharon Electric Light & Power Co., New Sharon, Ia.; $12,000; L. H. Ong, Jacob Wathands, Pierce Ratcliff.——Central Service Electric Co., Milwaukee, Wis.; $100,000; Francis Hinton, W. F. Powell, W. D. Van Dyke.——Electrical Annunciator Co., Portland, Me.; $500,000; Pres., E. W. Mann, Norfolk, Mass.; Treas., A. C. Allyn, Rochester, N. Y.——Mancelona Electric Light & Power Co., Mancelona, Mich.; $10,000.——Madera Electric Co., San Francisco, Cal.; $100,000.——Greenville Electric Light & Power Co., Greenville, O.; $15,000.

CONTRACT PRICES.

GRADING.—Alexandria, Va.—Edward Hughes has been awarded a contract for about 20,000 cu. yds. of grading streets in the second ward, at 16 and 19 cts. per cu. yd.

CULVERT PIPE.—Austin, Tex.—The lowest bid for supplying the city with culvert pipe until Dec. 1 was that of J. G. Taylor, at 15, 25, 35, 46, 70 and 85 cts. per lin. ft. for 8, 10, 12, 15, 18 and 20-in. double-strength pipe, respectively.

PIPE.—New York, N. Y.—The following bids were received Jan. 23 for 150 lengths of 12-in., 600 of 6-in. and 200 of 4-in. cast iron pipe (237 tons), the pipe to be delivered at the pipe yards, 24th St., East River, in this city: Jno. Fox, $19.30 per ton of 2,000 lbs. for pipe and $50 per ton for 50 tons of branch pipes etc.; Warren Foundry & Machine Co., $19.90 and $41; Camden Iron Wks., $19.45 and $46.

DREDGING.—Galveston, Tex.—The contract for dredging about 10,000 cu. yds. in channel across the bar at the mouth of Trinity River, has been awarded to Chas. Clarke & Co., at 32½ cts. per cu. yd. The channel is to be 5 ft. deep, 100 ft. wide and 1,200 ft. long.

Philadelphia, Pa.—The contract for dredging the Schuylkill River has been awarded to John Lynch, at 24¾ cts. per cu. yd.; appropriation, $10,000.

DITCH EXCAVATION.—Wapakoneta, O.—Samuel Craig, Co. Engr., informs us that the contracts for the West Prairie joint ditch, 71 sections, have been awarded as follows: Delaweare Clay Mfg. Co., Delaware, O., sections 1, 2 and 3, 2,400 ft. 15-in. tile, $583, and 3,600 ft. 18-in. tile, $1,106, all 3 ft. deep; W. J. Dull, Arcanum, O., 4 to 27, at 7.43 cts. per cu. yd.; J. B. Randolph, Arcanum, O., 28 to 35, at 7.8 cts.; Still & Rohrbacher, Wapakoneta, 36 to 38, at 7.51 cts.; 47 and 48, at 9.4 cts.; 50 to 52, at 10.9 cts.; 57, at 11.06 cts.; R. F. Howell, Wapakoneta, 39 to 42, at 8.33 cts.; C. M. Howell, Wapakoneta, 43 and 44, 8.38 cts.; F. M. Smith, Lake View, O., 45, 2,000 ft. 8-in. tile and 500 ft. 10-in., $116; 46, 1,200 ft. 10-in. tile and 1,300 ft. 12-in., $184; 53, 1,700 ft. 8-in. tile and 300 ft. 10-in., $157; 54, 828 ft. 10-in. tile and 1,172 ft. 12-in., $242; 66, 2,000 ft. 8-in. tile, $140; 67, 2,000 ft. 10-in. tile, $183; 68, 2,434 ft. 12-in. tile, $353; C. A. Shumate, Waynesfield, O., 49, 1,000 ft. 8-in. tile and 1,500 ft. 12-in., $180; 55, 2,000 ft. 12-in. tile, 4 ft. deep, $239; 56, 1,000 ft. 12-in. tile, 1,117 cu. yds. excavation, $211; 58, 200 ft. 8-in. tile, $8; 59, 1,409 ft. 10-in. tile, $90;

60, 2,065 ft. 8-in. tile, $99; 61, 1,500 ft. 8-in. tile, $78; 69, 558 ft. 5-in., 1,342 ft. 6-in. and 480 ft. 8-in. tile, $124; 70, 1,485 ft. 12-in. tile, $224; 71, 900 ft. 8-in. tile, $59; Tester & Gaskill, Wapakoneta, 62, at 9.8 cts.; 63, at 10.6 cts.; 64, at 9.9 cts.; Kelly Bros., Wapakoneta, 65, at 9.9 cts.

VIADUCT APPROACH.—New York, N. Y.—The department of public parks has awarded the contract for the construction of a viaduct approach from Ogden and Sedgwick Aves. to connect with Jerome Ave. approach to new Macomb's Dam bridge over the Harlem River, now being built, to (2) the Passaic Rolling Mills, at $99,226, the only other bid being that of (1) Sooysmith & Co., at $100,549. The prices were as follows:

Substructure.	1.	2.
Foundation pits, 2,400 cu. yds.	$4.50	$5.00
Filling, 300 cu. yds.	1.50	1.25
Concrete filling, 600 cu. yds.	7.00	7.25
Piles, 40 ft. or under, 162	9.00	8.00
Piles, 40 to 60 ft., 162	12.00	11.00
Yellow pine, 45 M. ft. B. M.	40.00	35.00
Pneumatic caissons, 815 cu. yds.	31.00	31.00
Pier concrete and mas., 522 cu. yds.	9.50	9.00
Piers 16 and 17, 220 cu. yds.	14.50	15.00
Masonry in abutment, 300 cu. yds.	12.50	13.00
Granite coping, 900 cu. ft.	2.40	2.25
Superstructure.		
Metal work, 1,100,000 lbs.	.0298	.028
3-in. gas pipe, 670 lin. ft.	.60	.55
Extra coat of paint, if required	500.00	600.00
Asphalt roadway, 1,500 sq. yds.	3.25	3.25
Asphalt sidewalk, 672 sq. yds.	3.00	3.00

SPEEDWAY.—New York, N. Y.—The department of public parks received bids Jan. 18 for the first section of the proposed speedway. The specifications call for but one sidewalk and the legislature last week ordered the construction of two sidewalks. The specifications are claimed to have been interpreted by some as meaning monthly payments, while other bidders state that their bids are on the supposition that no work is to be paid for until all has been completed. The contract has been awarded to Jas. D. Leary and it is probable that the specifications will be amended to include two sidewalks and monthly payments. The itemized bids are given below:

MISCELLANEOUS CONTRACTS AND SUPPLIES.

BONDS.—Kenyon, Minn.—Bids are asked until Feb. 20 for $6,000 of 6% 20-year municipal bonds. E. Rehuke, Vil. Pres.

PORTABLE WATER TOWER.—Cincinnati, O.—The board of fire trustees will receive bids until Feb. 3 for a portable water tower.

STREET SPRINKLING.—St. Paul, Minn.—Bids are asked until Feb. 5 for sprinkling the streets in 10 districts. J. T. Kerker, Clk. Bd. Pub. Wks.

BOILER AND ENGINE.—Rockdale, Tex.—It is stated that Richard Moore will receive bids for a 100-HP. Corliss engine and an 80-HP. tubular boiler.

PARK IMPROVEMENT BONDS.—Cleveland, O.—Bids are asked until Feb. 21 for $200,000 4% park improvement bonds. W. A. Madison, Cy. Aud.

DRAINAGE DITCH.—Rock Falls, Ill.—Bids are asked until Feb. 6 for constructing certain ditches, about 250,000 cu. yds. Engr., F. W. Sears, Prophetstown; attorneys, White & Sheidon, Rock Falls.

HARBOR IMPROVEMENT BONDS.—Portland, Ore.—Bids are asked until Feb. 8 for $10,000 of 5% 30-year bonds, being a part of the $500,000 authorized in 1891. Chas. E. Ladd, Treas. Port of Portland.

STONE AND SAND.—New York, N. Y.—The department of docks will receive bids until Feb. 8 for about 4,000 cu. yds. small cobblestone, 11,000 cu. yds rip-rap stone, 2,500 cu. yds. sand and 6,000 cu. yds. broken stone.

ELECTRIC FIRE ALARM.—Blair, Neb.—Bids are asked until Feb. 5 for a system of electric fire alarm; also for about two miles of No. 9 and No. 14 copper, coppered steel and galvanized steel wire. E. B. Carrigan, Cy. Clk.

SMOKE CONSUMER.—Kansas City, Mo.—Bids are asked until Feb. 20 for the furnishing and installation of a device for the prevention or abatement of smoke emitted from the furnace and smokestack of the plant in the city hall, as stated in our advertising columns. H. P. Langworthy, Secy. Bd. Pub. Wks.

CABLEWAY.—High Bridge, Ky.—Matthew Dugan, of the High Bridge Stone & Lime Co., is reported as organizing a company to construct a cableway across the Kentucky River, a distance of about 1,500 ft. It is stated that such a cableway to carry seven tons at 600 ft. per minute would cost $12,000.

DREDGING.—Boston, Mass.—Bids are asked until Feb. 6 for certain dredging in Neponset River, South Bay and Charles River. Henry W. Swift, Chn. Harbor Comrs.

Baltimore, Md.—The council is considering an appropriation of $20,000 to dredge Jone's Falls up to Gay St., and $20,000 for dredging the docks of the harbor.

IRONWORK, ETC.—Washington, D. C.—Bids will be received at the office of the supervising architect as follows: Feb. 9 for the floor arches, concrete filling, etc., for the public building at Newark, N. J.; Feb. 14 for roof and other work at Detroit, Mich.; Feb. 15 for the steel and ironwork of superstructure of a public building at Omaha, Neb. Jeremiah O'Rourke, Superv. Arch.

METAL MARKET PRICES.

RAILS.—New York: $24 to $25 at eastern mills and at tidewater; old rails, $12 to $12.50 for iron and $9 to $9.50 for steel. Pittsburg: $24 for standard sections. Chicago: $25 to $27; old rails, $12 to $12.50 for iron and $7 to $7.25 for steel.

TRACK MATERIAL.—New York: angle bars, 1.3 to 1.4 cts.; spikes, 1.7 to 1.9 cts.; track bolts, 2.2 to 2.4 cts. with square and 2.3 to 2.5 cts. with hexagon nuts. Chicago: angle bars, 1.4 cts.; spikes, 1.9 to 1.95 cts.; track bolts, 2.5 to 2.55 cts. with hexagon nuts.

FOUNDRY PIG IRON.—New York: $12.50 to $14. Pittsburg: $11.25 to $12. Chicago: $12 to $13.50.

LEAD.—New York: 3.2 to 3.25 cts. Chicago: 3.1 cts.

NAILS.—Pittsburg: $1.05 to $1.10 for wire and 95 cts. for cut at mill.

STRUCTURAL MATERIAL.—New York: beams, 1.55 to 2.25 cts.; channels, 1.6 to 2 cts.; angles, 1.55 to 1.7 cts.; tees, 1.7 to 2 cts.; universal mill plates, 1.5 to 1.65 cts.; steel plates, 1.4 to 1.55 cts. for tank, 1.6 to 1.65 cts. for shell, 1.75 to 2 cts. for flange, 2 to 2.5 cts. for firebox. Pittsburg: beams, 1.35 to 1.4 cts.; channels, 1.35 to 1.4 cts.; angles, 1.35 to 1.45 cts.; tees, 1.6 to 1.75 cts.; universal mill plates, 1.4 to 1.5 cts.; steel plates, 1.25 to 1.35 cts. for tank, 1.4 to 1.5 cts. for shell, 1.5 to 1.65 cts. for flange, 1.75 to 1.85 cts. for ordinary firebox and 2 to 2.15 cts. for railway firebox. Chicago: beams, 1.55 to 1.6 cts.; channels, 1.55 to 1.6 cts.; angles, 1.5 to 1.6 cts.; tees, 1.85 to 2 cts.; universal plates, 1.5 to 1.6 cts.; steel plates, 1.5 to 1.6 cts. for tank, 1.7 to 1.8 cts. for shell, 1.9 to 2 ct. for flange, 2.75 to 5 cts. for firebox.

MARKET NOTES.—The following notes on the present conditions of the iron and steel markets are taken from the "Journal of Commerce," New York: "Mill agents who keep a close watch upon proposed structural work of various descriptions, state that the prospects are somewhat brighter for a better business ere long, chiefly in the erection of new buildings and extensions in this city during the spring months. To that extent the prospects for a wider market for beams, girders, etc., are more promising, but competition from all sources is very keen, and estimates on prices are as low as any that have been made during the past three months. Tank and boiler plates are in quite as unenviable position, as far as prices are concerned, and there are no signs as yet of any improvement in ordinary merchant iron and steel. The particularly slow branch of the trade, however, is railway equipment. Orders for rails are being placed in an exceedingly slow manner, and new inquiries are far from being encouraging to expectations of improvement in the immediate future. Orders of locomotives and cars, to all accounts, show very little if any improvement. Pig iron shows no change for the better. In the absence of any decided improvement in the demand for the productions of mills and foundries, consumers buy in a very cautious manner, and dealers take no more iron than may be necessary to keep the supply necessary to supply their regular trade. There is some accumulation on furnace banks, and this causes enough selling pressure to keep prices irregular, particularly for low grade foundry and mill iron. Consumers in some quarters manifest a fair degree of interest in a few lines of old iron and steel, but they purchase in a very indifferent way. With no speculative or other competitive buying, prices show no recovery from the low level that has prevailed for some time past."

BIDS RECEIVED BY THE DEPARTMENT OF PUBLIC PARKS, NEW YORK, FOR THE FIRST SECTION OF THE PROPOSED SPEEDWAY.

Quantities.	Brodhead & Hickey.	John J. Hopper.	Isaac A. Hopper.	Steward & McDermott.	Jas. D. Leary.	Thos. Barry.	J. C. Rodgers & Co.	M. S. Coleman.	H. H. Brown.	John McCallum.	R. A. Malone & Co.	Clinton Stephens.	Michael J. Dady.
Excavation, 142,000 cu yds	$1.35	$1.20	$0.70	$0 98	$0.95	$1.00	$1 25	$1.00	$1.00	$1.02	$1.25	$1.20	$1.15
Filling, 215,000 cu. yds.	.25	.35	.25	.27	.24	.60	.25	.75	.40	.30	.20	.50	.19
Dredging, 100 000 cu. yds.	.24	.15½	.20	.18	.21	.20	.15½	.30	.25	.23	.20	.36	.20
Rock excavation 4 to 27 ft. below water, 2,300 cu. yds	11.50	15.00	10.00	7.00	8.95	8.00	8 00	12 00	12.00	8 00	15.00	14.50	7.00
Crib-bulkhead, 1,750,000 cu. ft.	.04½	.06	.06	.05½	.05⅝	.06	.06	.07	.05	.05	.07	.06¼	.07
Broken stone in crib foundations, 600 cu. yds.	1 40	1.50	.80	1 85	2.20	2 00	1.00	2.00	.50	2.00	1.50	1.50	3.00
Concrete in wall foundations, Ros. cem., 2,100 cu. yds.	5 00	5 00	5.40	5.50	4.70	4.50	5.00	5.50	5.50	4.80	4.50	8.00	4 50
" " " Port. cem., 2,500 "	6.75	8.00	9.00	10.00	7.90	6.00	7.00	7.50	8.00	8 65	6.00	10.00	7.50
Broken range mas. in ret. walls, Ros. cem., 13,000 cu. yds.	8.75	9.00	8.20	7.25	7.30	9.00	7.00	7.00	7.50	7.50	9.00	9 00	14.00
" " " Port cem., 1,930 "	10.00	12.00	9.20	7.50	8 40	12.00	9.00	9.50	10 00	8.00	10.50	10.00	14.00
Coursed gran. mas. in b'kh'd-wall, Port. cem., 670 cu. yds.	19.00	23.00	9.00	23.00	15 00	25.00	15.00	30.00	20.00	20.00	12.00	25.00	22.00
Granite coping, 2,570 lin. ft.	6.25	3.50	3.00	5.25	4.40	3.00	4.50	4.00	4.00	4.50	2.00	7.00	5.00
Dry rubble mas. in slope walls, 500 cu. yds.	3.90	2.00	1.50	3.50	2.20	4.00	2.00	3.00	3.00	2.20	4.00	4.00	4.00
Rip-rap in retaining wall foundations, 6,300 cu. yds.	1 02	1.00	1.00	.80	.60	.80	.70	2.00	1.25	.85	1.50	3.00	.50
4 ft. brick culverts, rubble mas. foundations, 630 lin. ft.	11.00	11.00	10.00	6.50	7.70	12.00	8.00	10.00	10.00	8.75	7.00	12.00	9.00
8 in. vitrified pipe culverts, 300 lin. ft.	1.10	.75	.40	.60	.55	.70	.75	.00	.65	.55	.50	.75	1.00
10-in. " " 1,350 "	1.70	.80	.75	1.10	1.10	1.00	.85	.80	1.30	1.50	.70	1.25	1.00
12-in. " " 1,186 "	1.75	1.00	1 00	1.35	1.20	1.50	1.00	1.00	1.40	1.00	.80	1.50	1.10
15 in. " " 630 "	2.25	1.25	1.50	1.95	1.60	2.00	1.25	1 25	1.90	1 80	.90	1.75	1.25
18-in. " " 550 "	2 75	2 25	1.75	2.25	2.00	2.50	1.50	1.50	2.25	2.00	1.00	2.10	2.00
24-in. " " 105 "	3.75	2 50	2.10	3.25	2.90	3.00	2.50	2.00	3.25	2 90	1.25	3.00	5.00
Manholes, complete, 9	42 50	40.00	20.00	37.00	45.00	60.00	50.00	100.00	32.00	85.00	50.00	58.00	50.00
Receiving-basin, complete, Dept. Pub. Wks.' pattern, 1	147.50	200.00	200.00	130.00	160.00	250.00	175.00	150.00	160.00	100.00	180.00	180.00	140.00
" " class "A," 18	122.50	250.00	150.00	130.00	120.00	200 00	125.00	100.00	125.00	130.00	90.00	160.00	150.00
" " class "B," 8	85.00	50.00	60.00	75.00	50.00	150.00	50.00	100 00	45.00	50.00	60.00	72.00	100.00
Gutter outlets, complete, 8	70 00	30.00	35.00	45.00	35.00	40.00	25.00	30.00	40 00	30.00	25.00	58.00	125.00
Walk inlets and gratings, complete, 10	35.00	20.00	15.00	25.00	17.00	40.00	20.00	20.00	18.00	30.00	15.00	33.00	125.00
Piles, left in foundations, 60,000 lin. ft.	.27½	.20	.20	.25	.24	.20	.25	.25	.25	.28	.25	.24	.25
Timber and plank, 50 M ft.	40.00	35.00	35.00	45.00	40.00	30.00	45.00	40.00	28.00	40.00	40.00	38.50	40.00
Sandy loam r'd'y, brok. stone and cin. found, 49,320 sq. yds.	1 42	.75	2.70	1.25	.78	1.40	.90	2.00	1.50	.83	.75	1.30	.59
Asp. pav., rubble stone Port. cem. conc. found., 123,580 sq. ft.	.32	.30	.25	.25	.24	.40	.22	.20	.30	.30	.45	.38	.20
Gravel walk, rubble stone foundations, 21,000 sq. ft.	.12½	.10	.06	.10	.12	.25	.10	.10	12	.13	.05	.50	.10
Cobblestone pavement in gutters, 570 sq. yds	1 25	.25	.50	1.25	1.00	.45	.50	2.50	1.00	1 50	1.75	2.00	1.50
New curbstone, fine axed, 6 × 22 in., 10,120 lin. ft.	1.55	1.25	1 25	1.35	1.40	1.30	1.25	1.00	1.50	1.35	.80	1.68	1.25
Bluestone coping, concrete foundation, 630 lin. ft.	4.50	4.00	4.00	4.00	5 00	3.25	4.00	4.00	4.50	5.00	.75	5.50	3.25
New bridgestones for cross-walk, 320 sq. ft.	.70	.70	.60	1.00	.90	.50	.60	1.00	.75	1 10	1.00	1.00	.75
Granite block pavement, taken up and relaid, 400 sq. yds.	.70	.20	1.00	1.25	.60	.50	.40	2.00	.70	.70	1.00	1.00	.75
Garden mold, including sodding, 1,000 cu. yds.	1.35	1.00	1.00	2.50	1.30	1.00	1.00	2.00	1.40	1.50	1.00	1.00	2.50
Total amounts	$767,258	$741,481	$708,908	$671,565	$629,916	$803,296	$665,288	$869,483	$738,706	$670,036	$734,606	$997,875	$734,489

CEMENT.—New York, N. Y.—The department of works has awarded a contract for furnishing and delivering about 8,000 bbls. of Portland cement to the Atlas Cement Co., at $1.82, the other bidders being A. C. Babson, $2.30, and Jas. Brand, $2.08 for quick and $2.15 for slow cement.

PIPELAYING.—New York, N. Y.—The following bids were received Jan. 23 for furnishing, delivering and laying water mains in Second Ave. between 58th and 42d Sts. and in 42d St. between 2d and 3d Aves, the bidders being: (1) Martin Lipps, $78,317; (2) Jno. Cornwell, Jr., $83,459; (3) W. J. Ford, $71,490; (4) Thos. Barry, $61,708; (5) F. Thilemann, Jr., $65,932.

	1.	2.	3.	4.	5.
Rock excav., 4,000 cu yds.	$5.00	$.50	$1.00	$.50	$1.30
Earth " 8,000 " "	1 50	.50	1.00	.50	1.30
Filling, 12,000 cu. yds.	.60	.01	.45	.50	.00
Straight pipe, 4,700 tons	20.00	20.00	22.50	22.00	22.00
Branches, 60 tons	45.00	40.00	51.00	50.00	49 00
Laying 48-in. pipe, 4,300 lin. ft.	1.15	4.00	1.60	1.00	1.00
" 36-in. " 700 " "	1.00	.70	1.00	1.00	1.00
" 30-in. " 300 " "	.75	.60	1.00	.90	1.00
" 20-in. " 50 " "	.50	.50	.50	.60	.75
" 12 in. " 1,000 " "	.30	.40	.40	.40	.50
" 6 in. " 200 " "	.15	.20	.30	.20	.25
36-in. stop cocks, 2	200.00	125.00	50.00	20.00	50.00
30-in. " " 1	200.00	75.00	50 00	15.00	50.00
12-in. " " 6	5.00	10.00	5.00	8.00	10.00
6-in. " " 6	5 00	8.00	5.00	5.00	8 00
Double-nos. hydrants, 6	5.00	10.00	5.00	7.00	10 00
Brickwork, 100 cu. yds.	.01	8.00	8.00	11.00	12.00
Concrete, 50 " "	.01	5.00	.01	4.00	4.00
Pav., flagging, 5,000 sq. yds.	.50	.20	.65	.40	.45
Granite paving, 400 " "	.50	1.00	1 00	.90	1.00
Curb and gutters, 100 lin. ft.	.01	.01	.01	.03	.07
Blow-offs, 3	50.00	20.00	8.00	20.00	10.00

INDUSTRIAL NOTES.

THE RHODE ISLAND LOCOMOTIVE WORKS, of Providence, R. I., have an order for ten engines for the Lake Street Elevated R. R., of Chicago.

THE RICHMOND LOCOMOTIVE WORKS, of Richmond, Va., have an order for engines for the Richmond & Danville R. R.

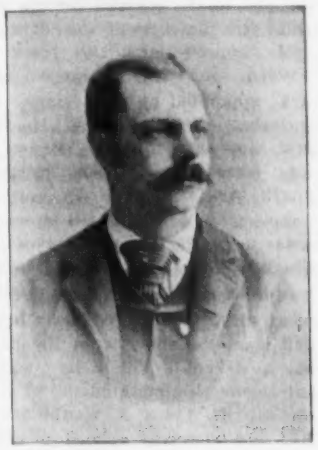
THE LACONIA CAR CO., of Laconia, N. H., is arranging to build electric cars, and has secured control of the patents on a combination car which may be made suitable for summer and winter use.

BENJAMIN WATSON, of New York city, dealer in railway supplies, has moved from 18 Wall St. to 33 Wall St., where he will continue the purchase of old and new rails, locomotives and other supplies.

NEW COMPANIES.—Dairy Car Co., Jersey City, N. J.; $150,000; E. L. Fuller, C. D. Simpson and T. H. Watkins, of Scranton, Pa.——Griffith Sand & Gravel Co., of St. Louis, Mo.; $25,000; B. P. Hogy, John O'Brien and J. A. Kunce.——McCosh Steel Co., Chicago, Ill.; $250,000; Thompson McCosh, A. Cooper and W. H. Leech.——Erie Construction Co., Buffalo, N. Y.; $100,000; building railways and docks, dredging, etc.; Charles F. Whitcher, C. C. Conroy and J. O. Taylor.——Standard Supply & Equipment Co., Camden, N. J.; $10,000, with $1,500 paid up; W. B. Henry, Philadelphia, Pa.; W. Sargent, Jr., Bridgewater, Mass.; John F. Jaline, Camden, N. J.

BIOGRAPHICAL DIRECTORY OF CITY ENGINEERS.

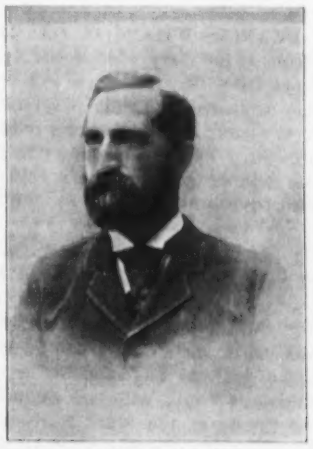
CAMPBELL WILLIAM ADAMS, Utica, N. Y., appointed by the Mayor for one year from March 1, 1893, having held same office in 1880, 1881, 1882, 1884 and 1892. Mr. Adams was born Dec. 9, 1852, in Utica, N. Y., and was educated at Utica public schools and academy and by private tutor with civil engineering in view. In 1872 he was an assistant in the City Surveyor's office at Utica, and was Assistant City Surveyor for some years. In 1883 he was engaged in railway engineering for the West Shore R. R. Co., and was a Division Engineer on the Delaware & Hudson R. R. for about one year. In 1887 and 1888 he was Resident Engineer on the R., W. & O. R. R., and from 1891 to 1892 he was Assistant Engineer in charge of the office of Chief Engineer of the Adirondack & St. Lawrence R. R.



HENRY CLAYTON ALLEN.

HENRY CLAYTON ALLEN, Syracuse, N. Y., was appointed by the Mayor for one year from February, 1893, having previously filled same office since October, 1890. Mr. Allen was born Sept. 10, 1864, in Newark, N. J., and graduated at the High School in Syracuse. From 1882 to 1886 Mr. Allen was associated with Mr. H. Wadsworth Clarke, of Syracuse, in general surveys and readjustment of boundary lines in the states of New Jersey, Pennsylvania and New York. From 1886 to 1887 he was Assistant City Engineer of Syracuse, with Mr. W. H. H. Gere, and until 1890 he was an assistant engineer upon the construction of the new Croton Aqueduct. Mr. Allen is a member of the firm of Mather & Allen, of Syracuse, N. Y., in general practice. He was elected Assoc. M. Am. Soc. C. E., July 1, 1891.

EDWIN P. AUGUR, Middletown, Middlesex Co., Conn., elected by Common Council for one year from February, 1893, and has been City Surveyor of Middletown since July, 1872. Mr. Augur was born Jan. 31, 1847, in Middlefield, Conn., and graduated from the Connecticut State Normal School in 1867. He commenced by assisting his father, who was a county surveyor, and for a time county deputy to the State Surveyor. He is now President of the Connecticut Association of Civil Engineers and Surveyors.



EDWIN P. AUGUR.

ASHER ATKINSON, New Brunswick, N. J., appointed by Common Council for an undefined term on May 1, 1891. Mr. Atkinson was born June 10, 1867, in Brooklyn, N. Y., and was educated at Rutgers College, and received his degree of C. E. in 1888. He was for four years engaged upon the New Jersey State Topographical Survey, and later spent two years in the office of C. C. Vermeule, of New York, in general practice. He is also now County Engineer of Middlesex Co., N. J.

HORACE ANDREWS.

HORACE ANDREWS, Albany, N. Y., appointed by Mayor and confirmed by Council for two years from May, 1892, having continuously held same office since 1886. Mr. Andrews was born March 19, 1852, in New Haven, Conn., and in 1871 and 1872 took the degrees of Ph. B. and C. E. at the Sheffield Scientific School. From 1872 to 1877 he was with the United States Coast and Geodetic Survey; 1877 to 1884 he was engaged on primary and secondary triangulation for the New York State Survey, and in 1884–1886 made scientific investigations under the New York State Board of Health. In the latter year he was elected to the office he now fills.

CHARLES A. ALDERMAN, Eau Claire, Wis., appointed by Common Council for one year from April 15, 1893, having held the same office for the previous 3½ years. Mr. Alderman was born May 21, 1865, in Spring Brook, Wis., and was educated at the Wisconsin State University. He commenced in 1885, in the City Engineer's office in Eau Claire, and after spending one year there was then continuously engaged in surveys and construction on the following railways: Sault Ste. Marie & Southwestern, Duluth, South Shore & Atlantic, South Pacific and Nevada & California. In 1889 he again entered the City Engineer's office of Eau Claire, as above.

E. BROWN BAKER.

E. BROWN BAKER, Gloversville, N. Y., elected by Common Council for one year from March 1, 1893, and is now filling his third term in same office. Mr. Baker was born March 6, 1870, in Kingsboro, N. Y., and was educated at Union College, Schenectady, N. Y. In 1889 he was assistant on the extension of the Gloversville waterworks, and in January, 1890, he was made Assistant to the City Engineer. He designed and constructed the Northville Water-Works.

HARRY T. BARKER, Beaver, Falls, Pa., appointed by Town Council for one year from March, 1893, having held the same position for the past 14 years. Mr. Barker was born Aug. 29, 1849, in New Brighton, Pa., and was educated in West Chester, Pa., and under Prof. George L. Fox, of the Cooper Institute, of New York. His practice has been mostly confined to general surveying and engineering in Beaver Co., Pa., and to the duties of his present office. He spent some time in the Worthington Pump Works, of South Brooklyn, and in the drafting department of the Morgan Iron Works, of New York.

HENRY DEMING BARTHOLOMEW, Lansing, Mich., appointed Oct. 25, 1893, by the Board of Public Works, during pleasure of board, having previously held the office of City Surveyor and Sewer Engineer from 1879 to 1883. Mr. Bartholomew was born Feb. 15, 1831, in Waddington, St. Lawrence Co., N. Y., and was graduated from the Michigan University, at Ann Arbor, in June, 1854. He commenced the practice of engineering in 1879, when he was principally engaged in surveying for the State of Michigan, swamp and overflowed land which had been deemed worthless and left unsurveyed by the original surveyors. He has been a special examiner of plats of land for the state since 1885. In addition to his surveying practice he has had very considerable experience in municipal engineering work.

GEORGE HENRY BENZENBERG, Milwaukee, Wis., appointed by the mayor and confirmed by council for three years from April 19, 1893, having held same office since 1882. Mr. Benzenberg was born May 31, 1847, in New York City, and was educated at the Michigan University. He was engaged for three years on the United States Lake Survey, and then spent four years upon railway location and construction. He was for eight years Assistant City Engineer of Milwaukee, and has now filled the office of City Engineer for 11 years.

NEWTON MORRIS BRANDON, Meridian, Miss., elected by Boards of Councilmen and Aldermen for one year from Jan. 1, 1893, having filled same office for three years previously. Mr. Brandon was born May 20, 1863, in Kentucky, and was educated in the public schools of Evansville, Ind. In 1880 he was engaged on surveys for the B., C. & W. Ry. from Cincinnati, and was later employed on construction for the N. O. & N. E. R. R. from Meridian to New Orleans, and spent the greater part of three years as Assistant Engineer in building the Lake Pontchartrain trestle, 22 miles long. He was then in the employ of the Louisville & Nashville R. R. Co. between Evansville and Hen-

NEWTON MORRIS BRANDON.

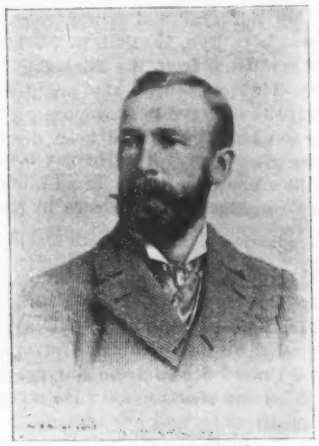
derson, and also upon the Ohio River bridge at Henderson, Ky. He returned to the N. O. & N. E. R. R. as assistant in maintenance of way between New Orleans and Meridian and Vicksburg. He was Chief Engineer of the G. & S. I. R. R.; made survey for the Memphis & Pensacola R. R.; was with N. O. & N. W. R. R. on construction, and finally opened an office for private practice in Meridian, Miss., which he still follows in connection with the duties of his office as City Engineer.

FRANCIS W. BLACKFORD, Jr., Butte, Mont., was appointed by the Mayor for one year from May 1, 1893, having previously been City Engineer of Anaconda, from 1889 to 1891, and of Butte from 1891 to date. Mr. Blackford was born Dec. 16, 1859, in New Columbus, O., and was educated at the Ohio State University, at Columbus. In 1879 he commenced as a rodman on the Cincinnati Southern Railway; was Assistant Engineer on the Union Pacific system, 1881 to 1885; Division Engineer in 1886, and Resident Engineer, 1887 to 1888. He has also a general practice in hydraulic, railway and mining engineering. M. Am. Soc. C. E., April 4, 1888.

LOUIS E. BROWNE, Richmond, Ind., appointed by Council for four years from September, 1892. Mr. Browne was born Nov. 15, 1865, in Springfield, O., and was educated at the Ohio State University. He was for four years in the office of the City Engineer of Columbus, O., and passed from that office to his present position.

WILLIAM P. BUTLER, Bloomington, Ill., elected by City Council for one year from May 1, 1893, having previously filled same office from 1890. Mr. Butler was born July 1, 1863, in Bloomington, Ill., and was educated in the schools of that city. From 1880 to 1890 he was Assistant City Engineer, in the latter year being made City Engineer. His specialty is brick street pavements.

ROBERT ANDREW CAIRNS, Waterbury, Conn., elected by Board of Sewer Commissioners for three years from May 17, 1893, having held same office for the past three years. Mr. Cairns was born Dec. 2, 1859, at Waterbury, Conn., and graduated in 1885 from the Rensselaer Polytechnic Institute. From 1882 to 1886 he was employed in the City Engineer's office in Waterbury during the summer, and on graduating at Troy he was made instructor in descriptive geometry and mechanical drawing from 1885 to 1887. In the latter year he was appointed Engineer of the water-works for Middletown, Del., and was also building mountain roads in Vermont. For several years he was Mechanical Engineer for the Ludlow Valve Mfg. Co., designed and built water-works for Centerville, Md., in 1889, and in 1890 became member of the firm of Hedden & Cairns, in New York, builders of structural iron work.



F. W. CAPPELEN.

FREDERIK W. CAPPELEN, Minneapolis, Minn., appointed by City Council for two years from Jan. 2, 1893. Mr. Cappelen was born Oct. 21, 1857, in Norway, and was educated at the technical school at Orebro, Sweden, and at the Polytechnicum at Dresden, taking a seven years' course in all. 1880 to 1881 he entered the service of the Northern Pacific Ry. as a draftsman, and in the latter year was Assistant Engineer in charge of location and construction on the same road. He was later with the St. Paul & Northern Pacific, at Minneapolis, and was Bridge Engineer from 1884 to 1886. From 1886 to 1892, inclusive, he was Engineer of Bridges and Buildings for the city of Minneapolis, and during this period he designed and built three iron and steel bridges across the Mississippi River, and constructed many public buildings and the North Minneapolis sewer tunnel.

FRED H. CARPENTER, Hutchinson, Kan., appointed by Mayor and confirmed by City Council for one year from May 19, 1893, having filled same office for the last nine years without interruption. Mr. Carpenter was born Sept. 20, 1857, in West Stephentown, N. Y., and was educated at the Kansas State University. He was first connected with the Atchison, Topeka & Santa Fe Ry., in 1879; was later on the Sonora Ry., locating engineer on the Arizona & New Mexico Ry., in charge of terminal works at Clifton, Arizona, and the works of the Arizona Copper Co., at Clifton. Remained in latter position until elected to his present office. Mr. Carpenter has also been County Surveyor of Reno County since 1886.

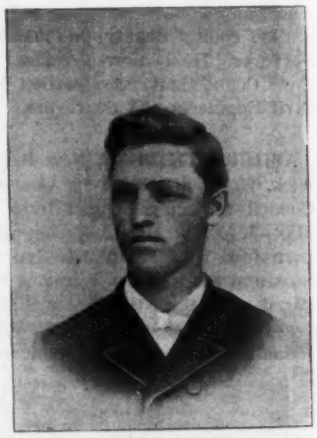
LOOMIS E. CHAPIN, Canton, O., elected by City Council for two years from Sept. 8, 1891. Mr. Chapin was born May 7, 1858, in Kewanee, Ill., and was graduated in 1883, in the School of Engineering of the University of Michigan. He was an Assistant Engineer on the F., A., A. & G. T. Ry. in 1880, and was connected with railway work until 1882. In 1883 to 1887 he was principal assistant to the City Engineer of Toledo, O., and from 1887 to 1891 he was associated with Mr. J. D. Cook, of Toledo, O., in general practice in building water-works and providing sewerage for about 25 cities and towns. He designed and built the sewage disposal works at Canton, O., and was also Consulting Engineer for Alliance, O., for sewerage and street improvements.

A. BROOKS CELIAX, Hazleton, Pa., elected by City Council for three years from June 1, 1892. Mr. Celiax was born June 23, 1868, in Hazleton, Pa., and graduated from the City High School of Hazleton. In 1885 commenced work on the surveys for the Schuylkill Division of the Pennsylvania R. R., from Pottsville to Hazleton; was then a rodman and later Assistant Engineer on the Lehigh Valley R. R., remaining with the company for seven years. He was also engaged in the construction of an extensive system of canals for protecting the underground coal workings from flooding, and in building the large reservoir near Mahoning City, of 22,000,000 gallons capacity. He was engaged in the surveys for the system of tunnels, 5½ miles long, for draining the Black Creek Coal Basin.

WILL. S. CLARK.

WILL. S. CLARK, Little Rock, Ark., appointed by City Council for one year from April, 1893, having held same office in 1892. Mr. Clark was born June 6, 1858, in Fort Smith, Ark., and was educated at Fayetteville, Ark. In 1881 he was a rodman on the construction of the Chicago, Texas & Mexican Ry. He was later engaged with the government survey of the Arkansas River and upon the surveys for the Kansas & Arkansas Valley Ry.; assistant engineer on maintenance of way for the St. Louis & Southwestern Ry., and he finally opened an office for general practice in Little Rock, Ark.

FRANCIS WHARTON DALRYMPLE, Bradford, Pa., elected by City Councils for three years from April 1, 1893, having served in same office since 1890. Mr. Dalrymple was born Feb. 4, 1861, in Lock Haven, Pa., and was educated at Lehigh University. He entered the employ of the Erie & Wyoming Valley Ry. as a rodman, and after two years' service he was appointed Assistant Engineer in the Maintenance of Way Department of the Erie Ry., at Port Jervis, N. Y. He was then Roadmaster of the Bradford Division of the Erie Ry. until elected City Engineer of Bradford.



J. EDWARD DAVIS.

J. EDWARD DAVIS, Oskaloosa, Ia., appointed by City Council for one year from April 3, 1893, and held the same office since 1891. He was born March 2, 1864, at Mahaska, Ia., and was educated at Oskaloosa College, with an engineering course at the State University of Iowa. Mr. Davis studied law at the State University of Iowa, and was admitted to practice in the Supreme and Federal courts in May, 1893. His engineering experience has been confined to the position now held.

ALBERT H. DAVIDSON, Augusta, Ga., elected by City Councils January, 1892, for three years, having filled same office continuously since 1878. Mr. Davidson was born April 19, 1851, at Augusta, Ga., and graduated from Lafayette College, Easton, Pa., in July, 1872. Immediately after leaving college he was appointed an Assistant Engineer on the Augusta Canal enlargement, a work costing nearly $1,000,000. He remained connected with that work until he was elected to his present office in January, 1878. He is also Consulting Engineer to the water-works and Hydraulic Engineer for the Augusta Canal.

WALTER ALEXANDER DOANE, Meadville, Pa., elected by Councils for two years from May 24, 1893. Mr. Doane was born Sept. 17, 1854, in Ellicottville, N. Y., and was educated at the Institute, in Bridgeport, Conn. In 1872–76 he was Assistant Engineer on the Lake Ontario Shore Ry., and for two years later he was in charge of surveys and location on Eastern Pennsylvania, Lehigh & Eastern Ry. He was Chief Engineer of the Meadville & Louisville R. R., and Principal Assistant Engineer on renewals

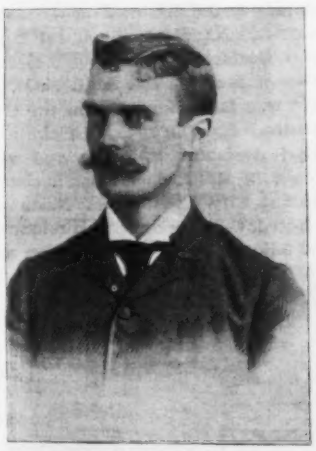
of Rome, Watertown & Ogdensburg R. R., on the Ontario & Quebec R. R. and for 3½ years he was Division Engineer in charge of drafting and designing office on Canadian Pacific Ry. He was for 2½ years Engineer of Bridges on the Oregon Pacific Ry., and to January, 1893, he was with the Norfolk & Western R. R. Co. as Principal Assistant Engineer on the Ohio extension. M. Am. Soc. C. E., Sept. 7, 1881.

JAMES GREENE DURBIN, York, Pa., elected by City Councils for three years from May, 1892, having held same office since 1889. Mr. Durbin was born in 1856 in England, and graduated in 1884 from the Rensselaer Polytechnic Institute, at Troy, N. Y. From 1884 to 1887 he was Superintendent of a coal mining plant in West Virginia and in the latter year he was assistant in making survey for the city of York, Pa., and continued with that office until elected as above.

JAMES GREENE DURBIN.

W. A. DARLING, Rock Island, Ill., appointed by the Mayor for an indefinite term in May, 1893. Mr. Darling was born November, 1864, at Rock Island, Ill., and was educated at the State University of Iowa. He was for three years in charge of work on the Kansas City, Watkins & Gulf Ry., in Louisiana, and spent some time in independent practice.

WILLIAM MADISON DUNLAP, Roanoke, Va., elected by Common Council for three years from July, 1892, having held same office for three years previously. Mr. Dunlap was born June 5, 1847, in Rockbridge Co., Va., and received his education at the Washington and Lee University, graduating as a Civil Engineer and B. S. He was Assistant Professor of Engineering and Chemistry at the same institution for two years, and then for three years he was Assistant to the City Engineer of Staunton. He was later engaged, principally in topographical surveying, in Virginia and West Virginia, and spent three or four years in railway surveys and construction in Virginia, West Virginia, Georgia and Florida.



LUTHER DEAN.

LUTHER DEAN, Taunton, Mass., elected by City Council, on May 11, 1893, until Jan. 1, 1894. Mr. Dean was born Nov. 21, 1867, in Taunton, Mass., and was educated at the Massachusetts Institute of Technology, in Boston. Since 1888 he has been engaged in general practice in Taunton, having had charge of the paving for the city in 1891. He is the first City Engineer that Taunton has ever had. Mr. Dean has also had experience as a contractor for sewerage and pipe laying.

HORACE L. EATON, Somerville, Mass., appointed by Mayor and confirmed by Board of Aldermen for one year from January, 1893, having held same office since 1887. Mr. Eaton was born Sept. 6, 1851, in Boston, Mass., and was educated in the English High School. In May, 1869, he entered the office of the City Engineer of Boston, and became Assistant City Engineer, and filled that position until elected to his present office. M. Am. Soc. C. E., Member Boston Society Civil Engineers.

GRIFFITH MORGAN ELDRIDGE, Americus, Ga., appointed by City Council for one year from Jan. 1, 1893, having filled same office since March 1, 1891. Mr. Eldridge was born Aug. 19, 1862, in Lee County, Ga., and was educated at the Rensselaer Polytechnic Institute. In 1885 he was Assistant Engineer in charge of machinery at the Novelties Exhibition, in Philadelphia. He then commenced railway engineering and was employed on the Louisville Southern, the extension of the S. & W. Ry., from Americus to Savannah, was Assistant Engineer in the office of the General Manager of the Central R. R. & Banking Co., of Georgia, and was later Resident Engineer on construction of the Savannah, Americus & Montgomery Ry. until appointed to his present office.

JAMES ANDREW FAIRLEIGH, Chattanooga, Tenn., elected by City Council for two years from January, 1890. Mr. Fairleigh was born Oct. 23, 1857, in Brandenburg, Ky., and was educated at the Rensselaer Polytechnic Institute, but did not graduate. From 1879 to 1882 he was engaged on general railway work in Illinois, and in the latter year removed to Chattanooga. He is at present Chief Engineer and Superintendent of the Harriman Coal & Iron R. R. Co. M. Am. Soc. C. E., Sept. 2, 1891.

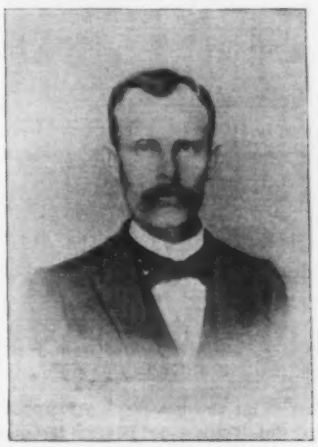
WALTER FRICK, Carbondale, Pa., elected by Councils for three years from May 1, 1893, having filled this same office since 1890. Mr. Frick was born April 2, 1862, at Lewisburg, Pa., and was educated at Lehigh University. He commenced engineering practice on the surveys for the N. Y., B. & W. R. R., then went to the Belfont extension of the Lewisburg & Tyrone Division of the Pennsylvania R. R., and was Assistant Engineer on the construction of the Shamokin, Sunbury & Lewisburg R. R. He was with the Lackawanna Iron & Coal Co., and for three years he was Division Engineer of the Pennsylvania Division, D. & H. C. Co.'s Ry.

LEWIS J. H. GROSSART, Allentown, Pa., elected by City Councils for three years from May 5, 1893, having been previously Borough Engineer of Bethlehem, Pa., in 1889–91. He was born Sept. 20, 1866, in Egg Harbor City, N. J., and was educated at Lehigh University, at Bethlehem, Pa. Mr. Grossart was Assistant Engineer on construction for the Lehigh Valley R. R. from 1886 to 1888, and was instructor in Civil Engineering in Lehigh University for one year. In April, 1889, he was appointed Borough Engineer of Bethlehem Pa., and served until he was elected to his present office. He was engaged with the United States Coast and Geodetic Survey during college vacations.

WINFIELD S. GAMBLE, Elgin, Ill., appointed by Mayor and confirmed by City Council for two years from May 1, 1893, having held same office for three years previously. Mr. Gamble was born July 25, 1861, in Evanston, Ill., and received his engineering education in the field. From 1879 to 1887 he was engaged upon various railways in location and construction, and for some time he was employed on topographical and geological surveys for the government.

WINFIELD S. GAMBLE.

LEWIS MOREY HASTINGS, Cambridge, Mass., appointed by Mayor for one year from April, 1893. Mr. Hastings was born April 17, 1853, in Weston, Mass., and was educated at Boston High School. In 1870 he entered the office of W. S. Barbour, Civil Engineer, in Boston, and in 1871 he was with J. G. Chase, City Engineer of Cambridge. He rose successively through the several grades of this office until appointed City Engineer as above.



JAMES BERNARD GASS.

JAMES BERNARD GASS, Fort Smith, Ark., appointed by City Council for one year from April 10, 1893, having previously held the same office since August, 1890. Mr. Gass was born Aug. 15, 1860, in Mexico, Mo., and was educated at the College of Engineering of the Missouri University, at Columbia. He was for several years Assistant to Mr. C. D. Rogers, City Engineer of Mexico, Mo., and in 1887 was engaged for a time on the surveys for the Fort Smith, Paris & Dardanelle Ry. Until 1890 he was Assistant and then First Assistant City Engineer at Fort Smith.

CHARLES COMSTOCK HOPKINS, Rome, N. Y., elected by Common Council for one year from March, 1893, having previously been City Engineer of Gloversville, N. Y., in 1889. Mr. Hopkins was born Jan. 22, 1860, in Jersey City, N. J., and took his degree of C. E. from Lehigh University in 1884. In 1882–83 he was engaged in railway engineering with the Pennsylvania R. R. Co., in charge of party. In 1884–88, inclusive, he was Assistant Engineer in the design and construction of waterworks in Sayre, Athens, Tunkhannock and Altoona, Pa.; Cambridge and Rome, N. Y., and Tampa, Fla. In 1888–89 he was associated with C. W. Knight, at Rome, N. Y., and since 1889 he has been connected with The Stanwix Engineering Co., of Rome, N. Y., in designing and constructing water-works, sewerage plants and other engineering works. M. Am. Soc. C. E., June 4, 1890.

MILTON B. HAYNES, Mankato, Minn., appointed by Mayor for two years from May 1, 1893, having previously filled this office in 1879–82, and from 1890 to present date. Mr. Haynes was born Dec. 9, 1834, in Storysville, O., and was educated at Oberlin College. For four or five years he was in the land department of the N. P. Ry. Co. and the Great Northern Ry. He was engineer of the bridge built across the Minnesota River at this point, and of the present sewerage system of the town. He is also Superintendent of the Water-Works at Mankato.

CARTER H. HARRISON.

CARTER H. HARRISON, Staunton, Va., appointed by Common Council for one year on Jan. 1, 1893, having held same office since 1890. Mr. Harrison was born in 1845, in Staunton, Va., and was educated at the Virginia Military Institute, at Lexington, Va. In 1868 he was a leveler under Chief Engineer H. D. Whitcomb, of the Chesapeake & Ohio R. R., and he remained with this road until its Cincinnati terminus was reached, reaching the grade of Division Engineer.

E. W. HATHAWAY, Pueblo, Col., elected by the people for two years from April 4, 1893. Mr. Hathaway was born Nov. 4, 1864, at Medford, Mass., and was educated at the Boston schools. In 1885 he went into the office of Mr. E. W. Bowditch, of Boston, and the same year was sent to Topeka, Kan., for the Topeka Land and Development Co., for which Mr. Bowditch was Engineer. In 1888 he came to Pueblo and after being employed by the Santa Fe Ry. Co. for a time he opened an office for general practice.

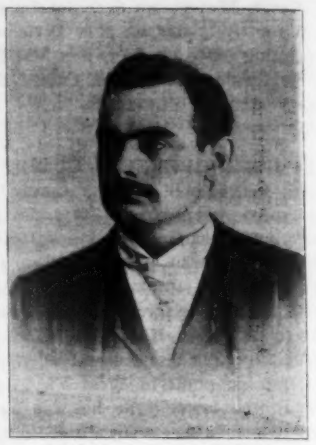
HARRY C. HEERMANS, Corning, N. Y., appointed by Mayor and City Council during their pleasure, and held the same office from 1880 to 1890. Mr. Heermans was born June 3, 1852, in West Virginia, and was educated at the Wesleyan University. He designed and built the water-works at Wellsboro, Pa., and at Corning, and has been Superintendent and Manager of the latter water-works since 1877.

ROBERT HOOKE, Chattanooga, Tenn., elected by the Board of Public Works for two years from April 1, 1892. He previously filled the same office in 1872–75 and 1890–91. Mr. Hooke was born Feb. 28, 1853, in Chattanooga, Tenn., and received his engineering education in the field. In 1870 he was an assistant Engineer on the Alabama & Chattanooga Ry., having entered the service of this company as a rodman. In 1871 he was the Assistant to Chief Engineer William P. Barker in laying out the town of Birmingham, Ala. In the following year he was engaged in general practice in Chattanooga, and in December, 1872, he was elected City Engineer. He held this position for three years and was then employed on the government improvements at the Muscle Shoals Canal on the Tennessee River; he commenced as Assistant Engineer, and from 1883 to 1887 he was in full charge of this work under Maj. W. R. King and Lieut.-Col. J. W. Barlow, Corps of Engineers, U. S. A. In 1887 he resigned this position and was made Superintendent of the Board of Public Works of Chattanooga, which position he resigned in July, 1888.

ROBERT HOOKE.

WILL BERNARD HOWE, Concord, N. H., elected by City Council for a term of two years from March 1, 1893, having practically held the same position in Concord since May, 1888. Mr. Howe was born July 3, 1859, in Concord, N. H., and was educated as an engineer in the office of Charles C. Lund and Foss & Merrill, having previously graduated from the Concord High School. He was engaged with the gentlemen named upon railway and municipal work until 1883, when he went to Nova Scotia as principal assistant on railway work. He returned to Concord in 1888 and took charge of the office of Foss & Merrill until he received his present appointment.

WILLIAM HARRY JONES, Keokuk, Ia., appointed by City Councils for one year from April 1, 1893, having held the same office in 1891–92. Mr. Jones was born Sept. 4, 1867, in Pilot Grove, Ia., and gained his professional education in the field and office. He was for two years on the Atchison, Topeka & Santa Fe R. R.; two years on Mississippi River improvement under Mr. M. Meigs, U. S. C. E.; one year with the Youngstown Bridge Co., and was then elected to his present office.

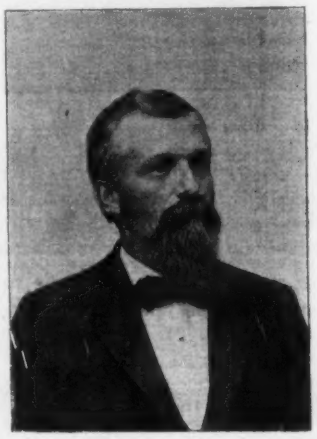


WILLIAM HARRY JONES.

CALVIN W. HENDRICK, Macon, Ga., appointed by City Council for three years from Jan. 1, 1891, having held this office since 1889. Mr. Hendrick was born in June, 1865, at Paducah, Ky., and received his engineering education in the field. In 1881 he entered the service of the C., O. & S. W. Ry., and was later in the employ of the city of Louisville, the Mobile & Ohio, and the G., S. & Fla. railway companies, and then was elected to his present position.

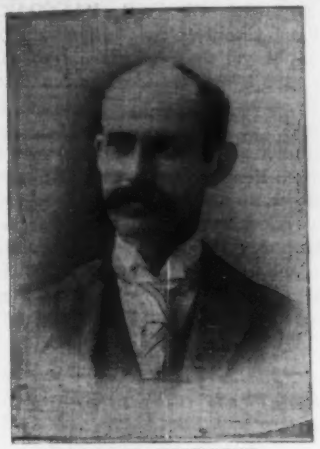
J. A. JOWETT.

JAMES ATKINSON JOWETT, Nashville, Tenn., elected by Board of Public Works and Affairs in 1885, during pleasure of said board. Mr. Jowett had previously been District Engineer and Surveyor of Manchester, Eng., from 1878 to 1884. He was born in England in 1847 and was articled as an engineering student, after the English practice, with Mr. J. Smith, of Bradford, Eng. Mr. Jowett was an Assistant Engineer on the Grand Rapids & Indiana and on the Jacksonville, N. W. & S. E. railways, and Resident Engineer on construction of the Houston & G. N. R. R. He was later Engineer on the Galveston, Hamburg & San Antonio Ry.; Assistant Engineer and Surveyor in Bradford, Eng.; District Engineer in Manchester, Eng., in charge of streets, sewers and buildings; Assistant City Engineer of Nashville, Tenn., for one year, and was then elected City Engineer. He inaugurated the system and has built about 30 miles of sewers in that city, and has also carried out an entire system of water-works, excepting only the distribution mains.



LEWIS KINGMAN.

LEWIS KINGMAN, Topeka, Kan., appointed by Mayor for two years from April, 1893, having held same office since April 16, 1889. Mr. Kingman was born Feb. 26, 1845, in Brockton, Mass., and after graduating from Hunt's Academy, at Brockton, he spent two years in the office of Shedd & Edson, Civil Engineers, of Boston, Mass. In 1864 he was employed in Wilkes-Barre, Pa., and in the Pennsylvania oilfields, and in 1868 he went to St. Louis, Mo. He then was with the Atlantic & Pacific Ry., in Missouri, and remained in that service until 1871. In 1871–72 he was engaged on railway work in Colorado and New Mexico, and in 1873–75 he was employed under the U. S. Surveyor General of New Mexico. He was later with the A., T. & S. F. R. R.; was transferred to the Atlantic & Pacific R. R. in 1879, as Locating Engineer, and in 1882 was made Chief Engineer. In 1883 he went to Mexico as Chief Engineer of the Mexican Central Ry., and built 452 miles of that line. After completing this work he returned to the Atchison, Topeka & Santa Fe Co. as Assistant to Chief Engineer Robinson, and was in charge of construction in Kansas, Indian Territory and Texas. He built 508 miles of railway in 1886 and 845 miles in 1887. M. Am. Soc. C. E., July 1, 1885.

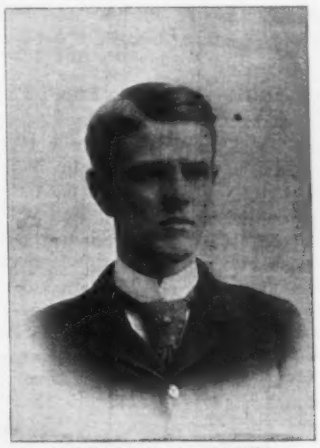


JULIAN W. KENDRICK.

JULIAN W. KENDRICK, Birmingham, Ala., appointed by Mayor and Board of Aldermen for one year from Jan. 1, 1893, having held same office since July 1, 1891. Mr. Kendrick was born Feb. 16, 1859, at Front Royal, Va., and was educated at the Virginia Military Institute and the University of Virginia. For three years he was instructor in mathematics, natural sciences and surveying at the Augusta Male Academy, in Virginia, and was then for three years with a firm of engineers and contractors at Roanoke, Va., on city, water-works, railway and mining engineering. He was later with the N. & W. R. R., in West Virginia; the Georgia, Midland & Gulf Ry., and the Eureka and other mining companies. When he resigned to accept his present appointment he had charge of coal mines with an output of 2,000 to 3,000 tons daily with 300 coke ovens.

HARVEY LINTON.

HARVEY LINTON, Altoona, Pa., elected by Common Councils for three years from April 17, 1893, having filled the same office since 1888. Mr. Linton was born Feb. 22, 1844, near Cochranville, Chester Co., Pa., and was educated at the Friends School at West Town, Pa. In 1865 he entered the service of the Pennsylvania R. R. Co. as a rodman and remained with that company until 1874. In July, 1881, he was engaged in mining and topographical surveys in Bedford Co., Pa., and to October, 1882, was locating and constructing Pittsburg & Western R. R. After that he was engaged as Assistant Engineer on the surveys for a new water supply for Philadelphia, and Engineer in charge of surveys and location for the Norfolk & Western Ry. until 1888. M. Am. Soc. C. E., Oct. 5, 1892.



SINGLETON H. KIMMEL.

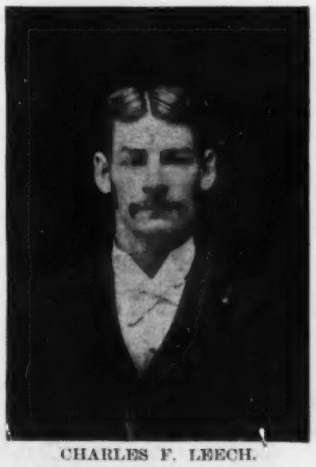
SINGLETON HUSBAND KIMMEL, Henderson, Ky., appointed by City Council for one year from Feb. 1, 1893, and has held the same since 1890. Mr. Kimmel was born in September, 1869, in Henderson, Ky., and was educated in a three-years' private course under Prof. J. Tevis Cobb. After being Assistant City Engineer of Henderson for about two years he was elected City Engineer in 1890.

GEORGE FOSTER KEY, Ann Arbor, Mich., appointed by Board of Public Works, at pleasure of board, on May 15, 1892. Mr. Key was born Oct. 13, 1860, at Horncastle, Lincolnshire, Eng., and was educated at the Michigan State Normal School and the Michigan State University in the engineering courses. His first professional work was connected with land surveying and drainage. In 1891 he had charge of the construction of the main sewers of Yipsilanti, under George S. Pierson as Consulting Engineer, and in 1892 was made City Engineer. Mr. Key was Assistant Professor of Mathematics in the Michigan State Normal School, for seven years.

HARVEY E. MANN.

HARVEY E. MANN, Ashtabula, O., appointed by City Council for one year from July 15, 1892, having held same office since 1885. Mr. Mann was born Jan. 3, 1841, in Ashtabula, O., and though he has had no special engineering education he has been engaged for many years in general municipal work.

WILLARD LEMON, Olympia, Wash., appointed by City Council for one year from March, 1892, having filled same office in 1891. Mr. Lemon was born Sept. 6, 1852, in Idaho, and graduated from the De Pauw University, at Greencastle, Ind., in 1880. From 1884 to 1888 he was engaged upon railway construction for the Chilian Government, and since then he has been engaged in a general land surveying practice in the State of Washington.



CHARLES F. LEECH.

CHARLES F. LEECH, Arkansas City, Kan., appointed by Mayor and confirmed by City Council for one year from April 23, 1893, and is now serving his third term of office. Mr. Leech was born Aug. 17, 1861, in Neosho Falls, Kan., and was educated for an engineer by special course. He was for some years engaged in location and construcion on the Atchison, Topeka & Santa Fe, and the Fort Worth & Denver railways. From this work he passed to the office now filled by him.

BENJAMIN M. LEE, Asheville, N. C., elected by Board of Aldermen for two years from June, 1893, having held the same office since 1887. Mr. Lee was born Nov. 4, 1845, in Buncombe County, N. C., and was educated at a private school. He was engaged for some years on railway work in Alabama and Florida, and was for several years Assistant to the City Engineer of Pensacola, Fla.

MARTIN L. NEWTON, Waterloo, Ia., appointed by City Council for one year from April, 1893, having previously performed similar duties in La Porte City, Ia., from 1877 to 1893. Mr. Newton was born May 27, 1851, in Freeport, Ill., and was educated as an engineer at Ann Arbor, Mich. He has been Chief Engineer on railway work for several years and has been County Surveyor for several terms, and Principal of the High School for three years.

C. F. L. McQUISTION.

C. F. L. McQUISTION, Butler, Pa., elected by Council and now serving his fourth term of office. Mr. McQuistion was born April 17, 1867, in Slippery Rock, Pa., and attended Grove City College. Is now serving his second term of three years as County Surveyor of Butler County, as well as filling the office of City Engineer.

FREDERICK R. LOCKLING, Hannibal, Mo., appointed by City Council for one year from May, 1893, having filled the same office in 1865–70 and 1886–93. Mr. Lockling was born March 31, 1829, in Lyndon, Vt., and was educated as an engineer in the office and field. He served under Chief Engineer Crane on the Watertown & Rome Ry. in 1845–50; under Mr. John B. Jervis, on the Michigan Southern & Lake Shore and Air Line Railways, and has filled all positions from axeman to Chief Engineer on many Western railways, east of Utah inclusive. He is also Sewer Commissioner of Hannibal, Mo.

HENRY H. PENDLETON, Independence, Mo., appointed by Mayor and confirmed by Council for one year from April 21, 1893, having held same office from April, 1892. Mr. Pendleton was born Sept. 29, 1864, in Independence, Mo., and was educated at the State University of Missouri. He was for a time with the County Engineers of Boone and Jackson Counties, and was for three years Assistant to the City Engineer of Independence before succeeding to the office now held.

JAMES M. MORRISON.

JAMES M. MORRISON, Tacoma, Wash., appointed by Board of Public Works, at pleasure of Board, in April, 1893, and has filled this office since November, 1890. Mr. Morrison was born May 2, 1864, in San Francisco, Cal., and was educated in the High School of Oakland, Cal. He has been continuously at work since 1880, mainly upon municipal engineering.

MORRIS LEVISTEIN, La Fayette, Ind., appointed by Common Council for two years from May 5, 1892, having filled same office since June 7, 1889. Mr. Levistein was born Jan. 1, 1868, in Hillsboro, O., and was educated at the Purdue University, La Fayette, Ind. His professional experience has been practically confined to the office now held.

THOMAS MURRAY, Davenport, Ia., appointed by City Council for two years from April 5, 1893, having continuously held the same office since 1868. Mr. Murray was born Sept. 22, 1845, in Dumfriesshire, Scotland. He received his engineering training in Davenport, Ia., and in addition to the office now held he has also been County Surveyor of Scott County, Ia., continuously since Jan. 1, 1868.

THOMAS MURRAY.

EDWARD S. MENDENHALL, Delaware, O., appointed by Mayor and confirmed by Council for one year from May, 1892, having held same office since 1891. Mr. Mendenhall was born Sept. 26, 1854, in Delaware County, O., and was educated at the Ohio Wesleyan University. For ten years he was engaged in various engineering operations in Ohio, Kansas and California.

HARRY PALMER.

HARRY PALMER, Wilmington, Del., elected by City Council for three years from February, 1892. Mr. Palmer was born Oct. 25, 1864, in Wilmington, Del., and was educated at the Lehigh University as a civil engineer. He was with the Edge Moor Bridge Works, the Jones & Benner Co., of Philadelphia, and with the Pennsylvania Ry. Co., on location and construction, on various lines in Pennsylvania, New Jersey and Delaware.

MAURY NICHOLSON, Knoxville, Tenn., appointed by Board of Public Works, at pleasure of board, in January, 1884. Mr. Nicholson was born June 14, 1859, in Columbia, Tenn., and was educated at the University of Tennessee. In 1880 he was a rodman on railway work and from September, 1880, to June, 1881, he was Assistant Chemist at the University of Tennessee. In 1882 he was Assistant Resident Engineer on the extension of the E. T., V. & Ga. R. R., and was later Resident Engineer on the L., N. O. & T. P. R. R. in Louisiana until 1883, when he was appointed to his present position.

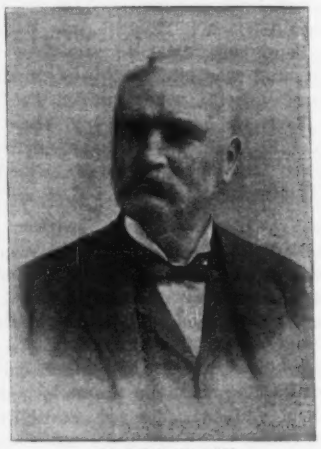
FRANK C. POWELL, La Crosse, Wis., appointed for two years from May 2, 1893. Mr. Powell was born Feb. 6, 1867, at La Crosse, Wis., and was educated at the Lawrence University, at Appleton, Wis. He was engaged in railway engineering on the Illinois Valley & Northern, the Minn. & N. W. and the C., B. & N. railways, and for a time was in charge of party on United States surveys on the Mississippi River. For the past four years he was Assistant City Engineer of La Crosse.

A. C. PANCOAST.

AARON COOPER PANCOAST, San Antonio, Tex., appointed by the Mayor and confirmed by Council for two years from March, 1893. Mr. Pancoast was born Aug. 13, 1865, at San Antonio, Tex., and graduated from Swarthmore College, Pennsylvania, June 19, 1888. He was engaged for a time in railway location and was then Mining Engineer for the Fronteriza silver mine in the State of Coahuila, Mex. He was Assistant City Engineer of San Antonio for four years.

FRED. W. PATTERSON, McKeesport, Pa., elected by Councils for three years from April, 1891. Mr. Patterson was born Jan. 29, 1860, in Pittsburg, Pa., and was educated at the Western University of Pennsylvania. In 1880 he was a rodman on the Pennsylvania R. R. and rose, in 1887, to be Supervisor of Track. He was then Engineer of Construction on the Pittsburg & Lake Erie R. R., Division Roadmaster N. Y., P. & O. R. R., Assistant Engineer Pittsburg & Lake Erie R. R., and in 1890–91 Division Engineer Maintenance of Way on the B. & O. R. R., Pittsburg division and branches.

GEORGE PLATT, Erie, Pa., elected by Councils for three years from April, 1891, having been temporarily in same office in 1871. Mr. Platt was born Dec. 17, 1824, in New Milford, Conn., and after receiving a common school education he followed the sea as a navigator until the Civil War destroyed American commerce. He commenced the study of engineering in 1868, and in 1872 he was made County Surveyor of Erie County, Pa., and held this office for 14 years, engaging at times in mining and railway work. During the early part of the Civil War he was in command of a United States transport carrying troops and provisions, and until 1865 was in the Register's office of the United States Treasury Department.



GEORGE PLATT.

JOHN EDWARD RAWLINS, Elmira, N. Y., elected by Common Council for one year from March, 1893, having filled same office in 1891. Mr. Rawlins was born Jan. 12, 1859, at Honeoye Falls, and was educated as an engineer in the office of Mr. E. A. Stillman, engaged on railway and hydraulic work. He spent three years on railways in New York, Connecticut and Colorado; for two years he was engaged in a general surveying practice and for two years more he was an Assistant in the City Engineer's office in Elmira.

DAVID ABELL REED.

DAVID ABELL REED, Duluth, Minn., appointed by Board of Public Works and confirmed by Common Council, until resignation or removal for cause, from July 19, 1892. Mr. Reed was born in Groveland, Livingston Co., N. Y., and was educated in the Academic Department of the Genesee State Normal School. He commenced engineering in 1881 as a rodman on the Genesee Valley Canal R. R. From 1882 to 1885 he was in general practice, and from 1884 to 1886 he was Secretary and General Superintendent of the Leicester Salt & Mining Co. From 1887 to 1888 he was Assistant Engineer to the City Engineer of Duluth, and from 1888 he was first assistant in the same office until appointed City Engineer.

WALTER P. RICE, Cleveland, O., appointed by Chief of Public Works for two years on April 25, 1893, having held same office from 1887 to 1890. Mr. Rice was born Sept. 2, 1855, in Cleveland, O., and was educated at

Lehigh University, graduating as C. E. in 1876. He was then engaged in road construction, dredging, and was Assistant Engineer in the building of the Superior St. viaduct at Cleveland. For six years he was United States Assistant Engineer on harbor work between Dunkirk and Detroit; was appointed Chief of Engineers for State of Ohio by Governor Hoadley, and was afterward in special practice as Consulting Engineer.

FRANK FOSTER ROGERS.

FRANK FOSTER ROGERS, Port Huron, Mich., appointed by Common Council for two years from May 15, 1893, having previously filled same position from May, 1891. Mr. Rogers was born Aug. 30, 1858, in Holloway, Lawrence Co., Mich., and was educated at the Michigan Agricultural College. In 1883 he was located at Marquette, Mich., in general practice, including railway, land and drainage surveys. Was for one year Engineer of Construction for the extension of the S., T. & H. R. R. from Bay Port to Bad Axe. In 1890 opened office in Port Huron, and was in general practice until appointed to above office.

ENOS L. SHAW, Marinette, Wis., appointed by Mayor and confirmed by Council for one year from May, 1893, having held the same office for the previous year. Mr. Shaw was born July 3, 1867, at Luray, Ind., and was educated in the School of Engineering of Purdue University, Lafayette, Ind., graduating in 1891. For the following year he was Assistant Engineer in charge of sewer construction in Menominee, Mich.

M. R. SHERRERD.

MORRIS ROBESON SHERRERD, Troy, N. Y., appointed by Mayor and confirmed by Common Council. Mr. Sherrerd was born in Scranton, Pa., Dec. 16, 1865; graduated from Rensselaer Polytechnic Institute, in 1886. He was Assistant Engineer on the Beech Creek R. R. in 1886, connected with the blast furnace department of the Lackawanna Iron & Coal Co., at Scranton, Pa., in 1887–88; assistant on location and construction of the Ontario, Carbondale & Scranton Ry. in 1889; with Public Improvement Commission of Troy, N. Y., in 1889–90; Assistant City Engineer of Peoria, Ill., in 1890-91; Engineer of Mechanicsville Water-Works in 1892–93, and made surveys for extensions. He was employed on the Troy Water-Works in 1892-93, and in May, 1893, he was appointed City Engineer of Troy, N. Y., for a term of two years. Mr. Sherrerd is an Assoc. M. Am. Soc. C. E. and Member Am. Inst. M. E.

SAMUEL C. SLAYMAKER.

SAMUEL C. SLAYMAKER, Lancaster, Pa., elected by Councils for one year from April 3, 1893, having filled same position in 1886–88. Mr. Slaymaker was born April 22, 1828, in Salisbury, Lancaster Co., Pa., and was educated at the Bellevue Academy and under private tutors. In March, 1852, he commenced his professional life and since then has been almost continuously engaged in railway work, having filled every grade to Chief Engineer of various railways. He was for some time Resident Engineer on the Philadelphia & Reading R. R.; Assistant Engineer on the Pennsylvania R. R.; he was with Mr. John C. Trautwine on the Honduras Interoceanic Ry., and has lately been Chief Engineer of the Lancaster, Oxford & Southern R. R. and the Reading, Lancaster & Baltimore R. R. He is now in charge of the electric railway system in and about Lancaster in addition to his duties as City Engineer.

EUGENE HICKS SHIPMAN, South Bethlehem, Pa., elected by Councils for one year from March 1, 1893, having filled same office since 1889. Mr. Shipman was born March 18, 1863, in Clinton, N. J., and was educated at the Lehigh University. He commenced his professional life in the service of the Delaware, Lackawanna & Western R. R., the Lehigh Valley Ry. and the Pennsylvania Coal Co., and then entered upon present employment.

CHARLES M. SLOCUM, Springfield, Mass., elected by City Council for one year from Feb. 3, 1893, having held same office since 1885. Mr. Slocum was born July 19, 1854, in Tolland, Mass., and was educated at Wesleyan Academy and under private tutors. His experience is chiefly confined to municipal work, sewerage, water supply and street improvements for the city of Springfield. He had some experience in railway work in 1873–75.

FRANK ADELBERT SMITH, St. Cloud, Stearns Co., Minn., reappointed by City Council for one year from April 10, 1893, having held his present office since Feb. 9, 1891. Mr. Smith was born in East Corinth, Me., on March 14, 1868, and was educated at the Maine State College, at Orono. From June, 1888, to February, 1889, he was employed on the preliminary surveys of the Northern Maine Ry., and from April, 1889, to the date of his election to City Engineer he was the Assistant City Engineer of St. Cloud.

THOMAS STEWART SEDGWICK, San Diego, Cal., appointed by Board of Public Works, at pleasure of board, October, 1892. Mr. Sedgwick was born in August, 1828, in Zanesville, O., and as no engineering schools then existed in his neighborhood he gained his experience in the field. In 1852–54 he was engaged upon the Central Ohio Ry., and later upon the Marietta & Cincinnati and the Ohio & Mississippi railways. He was in private practice from 1855 to 1861, and in 1863 to 1865 was a Captain and Topographical Engineer during the Civil War. In 1867–68 he was engaged in the surveys for the Kansas Pacific Ry. from Fort Riley to California, and as Chief Engineer surveyed a railway line from San Diego to Fort Yuma, Ari. In 1873, 1874 and 1875 he was in charge of surveys for the Chesapeake & Ohio Canal, and later in charge of public buildings in Austin, Tex., and in 1878 in charge of improvements at Aransas Pass, Tex. Mr. Sedgwick was also Colonel of the 114th U. S. C. T. M. Am. Soc. C. E., July 20, 1870.

CHARLES H. VINAL, Appleton, Wis., appointed by City Council for one year from April 15, 1893, having held same position since 1890. Mr. Vinal was born Sept. 10, 1858, in Iowa, and was educated as an engineer in Boston, Mass. He was engaged in railway engineering for two years with the Old Colony R. R. Co., in Massachusetts, and was then for ten years connected with the Milwaukee, Lake Shore & Western R. R. He later spent two years in the service of the Milwaukee & Northern R. R. and one year on the Wolf River Branch R. R. in Wisconsin.

WILLIAM STEYH.

WILLIAM STEYH, Burlington, Ia., elected by City Council for one year from April 3, 1893, having filled the same office in 1882–83, and from 1885 to date. Mr. Steyh was born Sept. 17, 1845, in the Grand Duchy of Hesse, Germany, and was educated in his profession in a surveyor's office in his native country. From 1859 to 1867 he was engaged in land surveying, road improvements and railway construction in Germany. In May, 1867, he came to the United States and found employment on the B. & M. R. Ry. in Iowa and Nebraska, and remained with this company until 1870. In 1871–72 was in charge of a small water-works plant at Mt. Pleasant, Ia., and in 1873–78 followed a private business in surveying and engineering until first elected to his present position.

JOHN W. WADE, Helena, Mont., appointed by Council for one year from May 1, 1893, having previously filled same office in 1887 and 1888. Mr. Wade was born in Sturgeon, Mo., Sept. 10, 1853, and was educated at the Missouri State Polytechnic Institute, at Columbia. He was engaged for two years as Locating Engineer on the Northern Pacific Ry., and later as a Government Land Surveyor. For the past ten years he has been chiefly employed in mining engineering and mountain road location.

J. W. STRACK, Spokane, Wash., appointed by Mayor and confirmed by Council for one year from May 2, 1893, having filled same office in 1888–89 and 1892–93. Mr. Strack was born Jan. 26, 1856, in Kent County, Mich., and was educated in private schools and in the field. Until 1887 he was engaged upon railway work, and in the latter year opened an office for general practice in Spokane. In connection with his present associate, Mr. Byron C. Riblet, he has been chiefly engaged in electric street railway installations and bridge bunding.

J. W. STRACK.

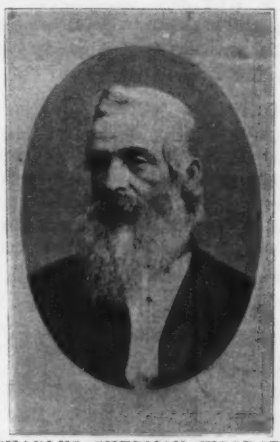
HENRY H. WAGONER, Huntington, Ind., elected by Common Council to fill office to Sept. 1, 1894, having held same position in 1891–92. Mr. Wagoner was born March 8, 1858, in Huntington, Ind., and obtained his engineering education in the field. In 1880 he was Deputy Surveyor of Huntington County and was elected County Surveyor in 1882 and again in 1884. He is in general surveying practice in Indiana and Michigan.

JAMES M. WAUGH, Crawfordsville, Ind., appointed by Common Council for two years from March 10, 1893. Mr. Waugh was born July 18, 1859, in Montgomery County, Ind., and graduated in 1883 from Purdue University. For six years he was Surveyor for Montgomery County and was Deputy Surveyor for two years. He laid out and built about 300 miles of drains and sewers and 200 miles of turnpikes or gravel roads. In general practice as a land surveyor.

COLIN REED WISE, Passaic, N. J., appointed by Mayor and confirmed by City Council for one year from April 11, 1893, having held same office since May, 1889. Mr. Wise was born Nov. 28, 1845, in Washington, Pa., and graduated in 1868 from Dartmouth College. He began his professional career in 1869 as Assistant Engineer on the Hackensack & N. Y. Extension R. R. He was Assistant Engineer on the Northern Pacific R. R., in Minnesota, in 1870; Resident Engineer, New Jersey & New York Ry., 1871–73, and Chief Engineer of the same from 1873 to 1875. From 1875 to 1877 he was Assistant Engineer of General Inventory, Erie Ry., and from 1877 to 1880 was Assistant Engineer on the Third and Ninth Avenues elevated railways in New York. He was Resident Engineer of the New York, West Shore & Buffalo R. R., from 1880 to 1882; Chief Engineer and Superintendent of Construction of the Brunswick & Western Ry. in 1882–84, and Assistant General Manager of the same in 1884–85; Resident Engineer of St. Louis & San Francisco Ry. in 1885–88, and then appointed to present office.

WILLIAM M. WHITTEN, South Bend, Ind., elected by Common Council for four years from May, 1892, having held the same office continuously since May 1, 1871, excepting for one year. Mr. Whitten was born March 1, 1845, in St. Joseph County, Ind. He was surveyor of St. Joseph County for 1865–69, 1872–74 and 1880–88; was County Drainage Commissioner and Engineer from 1881 to 1892, and since 1889 he has been to date Chief Engineer of the State Board for the improvement of the Kankakee River. He is now President of the Indiana Engineering Society. During the Civil War Mr. Whitten served in the Ninth Indiana Volunteers and the 21st Battery, Indiana Volunteers, for three years and three months, leaving the service as Second Lieutenant.

WILLIAM M. WHITTEN.



CHARLES SHERMAN WOODARD.

CHARLES SHERMAN WOODARD, Ypsilanti, Mich., elected by Common Council for one year from May, 1893, having previously filled several terms in same office. Mr. Woodard was born Oct. 22, 1821, in Rose, Wayne Co., N. Y., and received his engineering education in the office and field. In 1850 he was Assistant under Chief Engineer Edwin F. Johnson, on what is now the Chicago & Northwestern R. R. He was then with the Mich. C. R. R., under Col. J. M. Berrien; Chief Engineer of New Albany & Salem, now Louisville, New Albany & Chicago R. R.; Engineer for Land Drainage, 1864–67; Chief Engineer of the Jackson, Lansing & Saginaw R. R.; 1867–70, Chief Engineer of Fort Wayne, Jackson & Saginaw R. R.; 1870–72, Chief Engineer of Fort Wayne, Muncie & Cincinnati R. R.; 1873, Chief of what is now a part of the Wabash system; 1880–85, Chief Engineer of Wisconsin & Michigan R. R., and since then in general practice. In 1848 he was engaged on the United States land surveys in the Michigan iron and copper regions and was for a time Deputy United States Surveyor, near Thunder Bay. For nearly 20 years he has been regularly elected County Surveyor for Washtenaw County, Mich.

(TO BE CONTINUED.)

THE foregoing papers are the beginning of what we hope, by successive editions, to make a tolerably complete biographical directory of the City Engineers of the country.

City Engineers are requested to aid us in accomplishing this end by filling up the blanks already sent them, or asking for new blanks to be sent; photographs are solicited, and will be returned if desired. The biographical sketches will be prepared from official records only, and will aim to be as complete as possible.

There is no expense of any kind to City Engineers who furnish us the information desired for this supplement.

For blanks, address

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